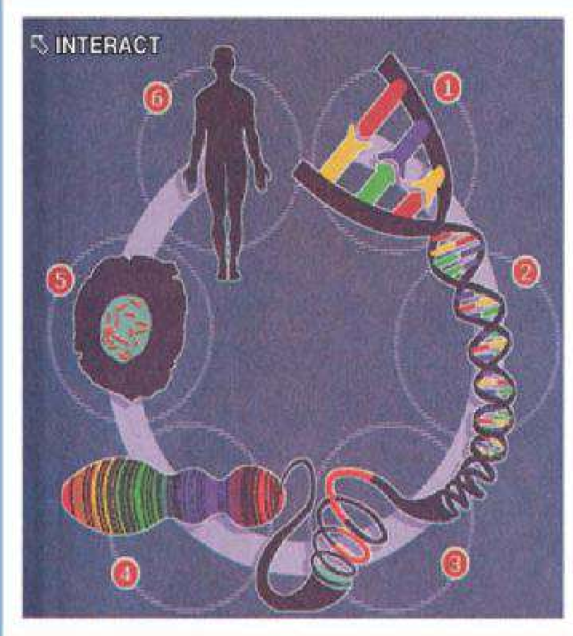


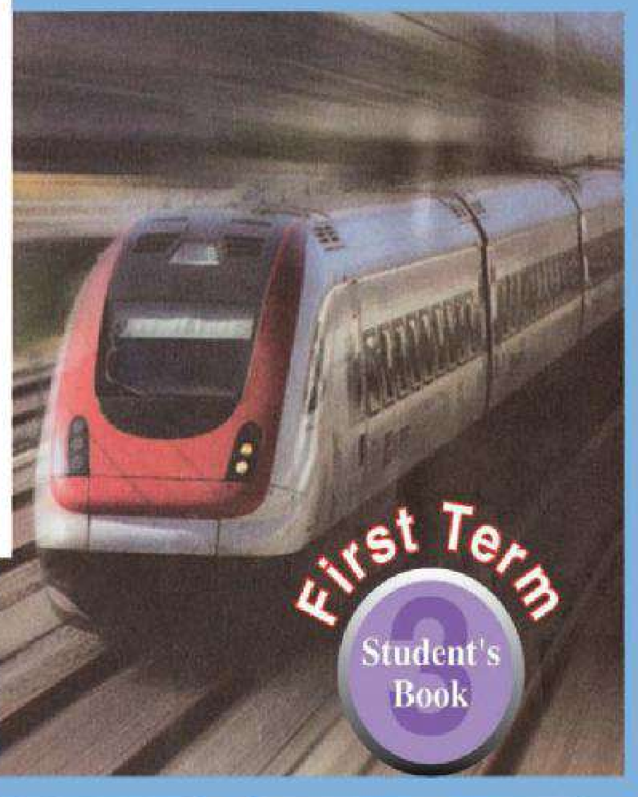
Arab Republic of Egypt
Ministry of Education &
Technical Education
Central Administration of
Book Affairs

Science and Life

Discover and Learn

Third Preparatory





2023 - 2024







Prepared By

Mr.
Mohamed Reda A. Ibrahim

Dr.
Mohamed Ahmed Abu leila

Dr.
Ahmed Reyad A. Hassan

Dr.
Usama Gebril Ahmed

Science Consultant :
Dr. Aziza Ragab Khalifa

Reviewed by
The General Administration for planning
and Formulating Curriculum

Supervised by
Dr Akram Hassan Mohamed
Head of the central Administration for the
Development of Curricula

Introduction

This book is considered a cornerstone in the second preparatory developed science curriculum, that achieves the objectives of developing curricula in order to cope with the 21st century.

Our curriculum aims to achieve the following educational directions:

- Highlighting the relation between Science and Technology in the science domain and its reflection on the development process.
- Emphasizing the suitable situations that distinguish the effect of the scientific and technological progress in producing knowledge.
- Emphasizing students practicing their active and conscious behaviour toward using the technological outcomes.
- Emphasizing students ability in the scientific thinking methodology, then the possibility for them to move from learning depending on receiving knowledge to learning depending on self-learning in an atmosphere of joy and amusement.
- Students depending on exploring to reach information and gain much experiences through developing the essential thinking skills such as observation, analysis, concluding and reasoning.
- Providing opportunities to students for practicing citizenship through the methods of self-learning and the team work spirit, negotiating and confessing, accepting others and rejecting extremists.
- Enriching students with various life skills, and the practical capabilities through increasing all interests in the practical and scientific domain.

This book contains four integrated units, each one contains a set of integrated lessons achieving the concerned objectives.

We hope that this book may benefit our sons for the favour of our country Egypt.

Preparation Team

CONTENTS

Unit 1: Force and Motion



Unit 2: Light Energy (Mirrors and Lenses)



Unit 3: The Universe and the Solar System



Unit 4: Reproduction and Species Continuity

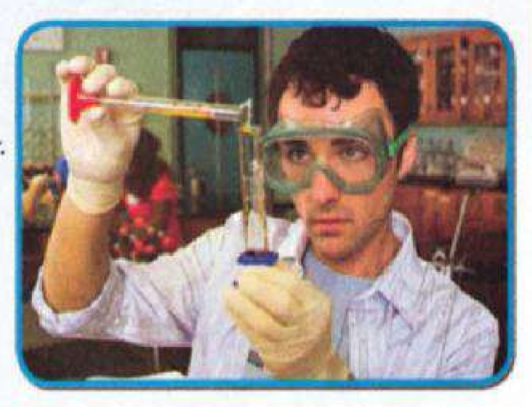


Safety in Science

Scientists know that they must work safely when doing experiments. You need to be careful when doing experiments too. Here are some safety tips to remember.

Safety Tips

- ✔ Read the steps of each experiment carefully.
- ✔ Wear safety goggles when needed.
- ✔ Clean up spills right away.
- ✔ Never taste or smell substances unless directed to do so by your teacher.
- ✔ Handle sharp items carefully.
- ✔ Tape sharp edges of materials.
- ✔ Handle thermometers carefully.
- ✔ Use chemicals carefully.
- ✔ Dispose of chemicals properly.
- ✔ Put materials away after you finish an experiment.
- ✔ Wash your hands after each experiment.





The first term - Unit one

Force and Motion

Introduction

In 1964, Japan operated the first fast electric train. The speed of this train reaches 200 kilometers / hour. This train was developed afterwards so that its speed reached 270 kilometers / hour, and it was named " The Bullet Train ". The difference between this " bullet train " and other trains is that each of its carts is operated by an engine of its own. In this way, the train can move at extreme speeds more than the train that consists of a chain of carts pulled by one engine. The " bullet train " can move at an increasing velocity not a decreasing one.



UNIT OBJECTIVES



By the end of this unit, students should be able to :

- ✓ Describe motion and mention its types.
- ✓ Identify physical quantities necessary to describe the movement of objects.
- ✓ Link motion's laws to real life situations.
- ✓ Acquire mental skills in solving examples and problems on motion's law.
- ✓ Represent uniform speed graphically.
- ✓ Calculate the average speed of a moving object.
- ✓ Identify the concept of relative speed.
- ✓ Identify the concept of acceleration.
- ✓ Mention examples of some standards and vectors as physical quantities,.

Included issues

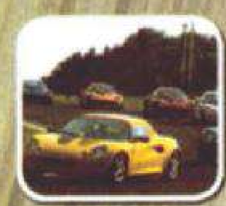
- Safety and security.



Lesson 1
Motion in one direction



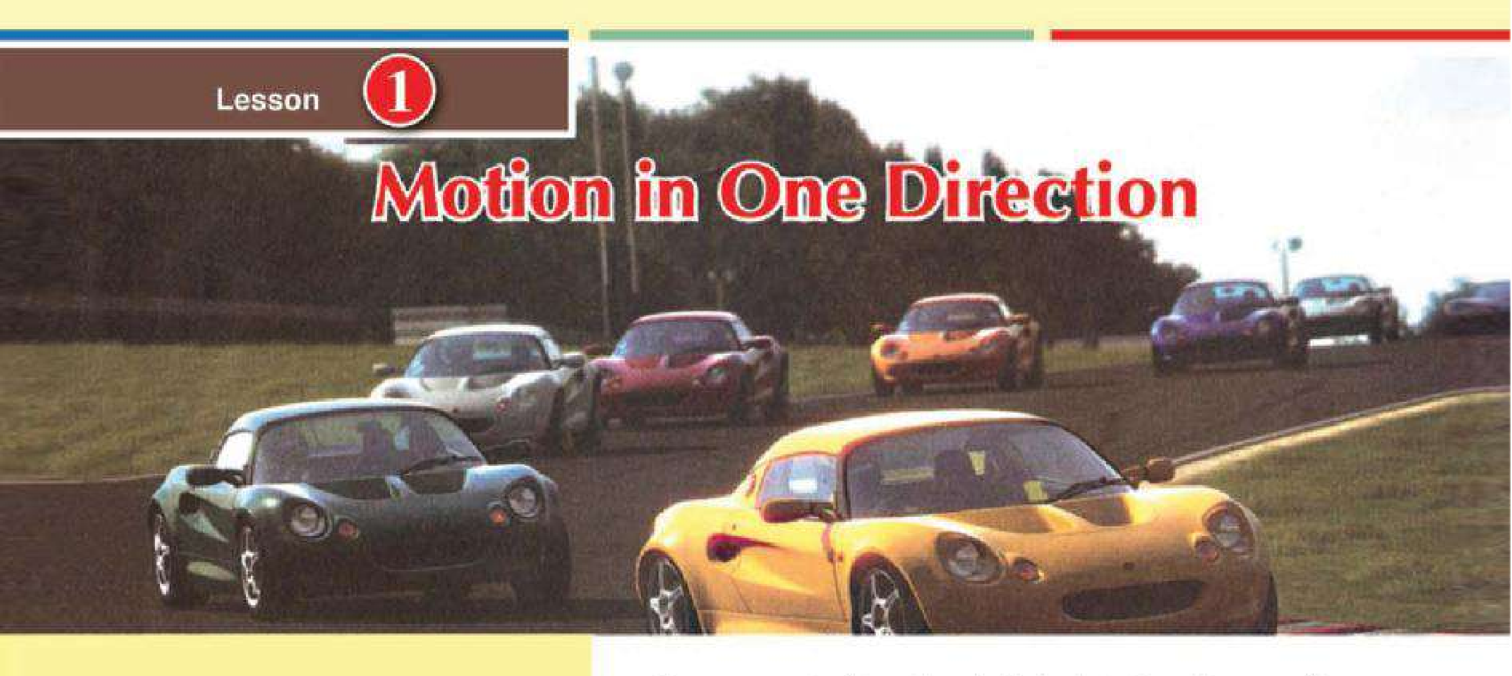
Lesson 2
Graphic representation of the motion in a straight line



Lesson 3
Physical quantities scalars and vectors

Lesson 1

Motion in One Direction





Lesson objectives

By the end of this lesson, students should be able to:

- Describe motion identifying distance, time and speed.
- Distinguish between regular motion and irregular motion.
- Identify the concepts of uniform speed, irregular speed and average speed.
- Calculate the constant uniform speed of a moving object.
- Use the mathematical relation in calculating the average speed of amoving body.
- Identify the concept of relative speed.



Lesson terms

- Regular speed.
- Average speed.
- Relative speed.

The concept of motion is linked to the change of an object's Position as time passes according to the Position of another object. To simplify the concept of motion, we only assume that the motion occurred in one direction such as the movement of the metro or train on rails is an example of moving in one direction. In this movement, the train moves forward or backward but it does not move upward or downward. Its path may be straight, curving or a combination of both. If the movement' path is straight, It Is Called Straight Line Motion Which Represents The Simplest type of Motion



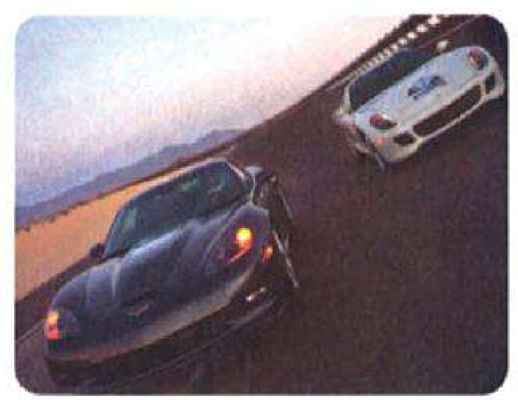
Figure (1): Metro movement is an example of one direction movement

Speed

In our daily life, the motion of object is described as fast or slow. To compere between the two concepts the term "speed" is used.

Example:

- If two cars – black car and white car – move on the same road (path,) the black car takes a time (t_1) in covering this path while the white car takes time (t_2).
- If the time span (t_1 second) is less than the time span (t_2 second), which one of these two cars is faster why? ....



as in figure (2) which one of the two cars is faster ? why ?

If the two cars move in two paths of different lengths,

- **If the path length of the black car is (d1 meter) and that of the white car is (d2 meter) which is shorter than d1.**
- If the two cars cover the two paths at the same time span although d_1 is longer than d_2.
- Which one of the two cars is faster ?

  why? ....

  Conclude what are the two factors necessary for the movement descripion

  1- ....

  2- ....

We can conclude that the length and the time are the two basic factors necessary to describe the movement. **Based on these two factors, we can identify a physical quantity called "speed".**

> Speed: it is the distance moved through a unit time.

If an object covers a distance (Δd) with a short time span (Δt), the object's speed (v) during this time is

$$\text{speed} = \frac{\text{distance}}{\text{time}} \quad \text{i.e.} \quad V = \frac{\Delta d}{\Delta t}$$

Uniform speed

Cars and planes are usually provided with a group of counters as speedometer, mileage, hour timer and compass.

The speedometer helps us in identifying the speed of the car directly. If the speedometer's pointer points to 72, this means that the car's speed is 72 kilometer/hour which is approximately 20 meters/second. If this reading stays constant during travel, we say that the car moves at regular (uniform) speed. This means that the car covers **equal distances in equal periods of time.**

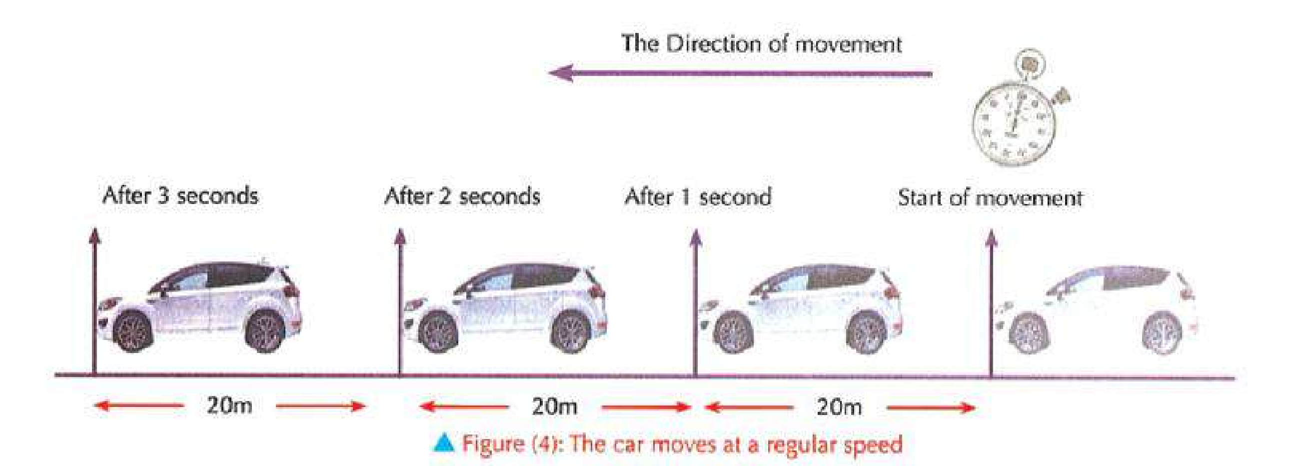


▲ Figure (3): Speedometers

Speed is measured in meter / second (m/s), when distance is measured in meter and time is measured in second. It is also measured in kilometer / hour (km/h), when distance is measured in kilometer and time is measured in hour (as in the case of cars, trains, planes and ships, ...)

when the time equals 1 second and the distance is 1 meter, so the speed $= \frac{\text{distance}}{\text{time}} = 1\text{m/sec}$

The following figure represents a car moving in a straight road



▲ Figure (4): The car moves at a regular speed

Study this figure and answer the following questions:

- What is the distance coveres by the car in each second?
- Does the car cover equal distances in equal periods of time? (Yes / No)
- What is the speed of the car? ....meter / second.
- Does the car move at regular (uniform) speed? (Yes / No)

Generally, when the movement is at regular speed, the moving object covers equal distances at equal periods of times whether the distance and time are short.

This means that $V = \frac{d}{t}$ **for regular speed only**

Where (d) is the distance moved during a period of time (t).

Irregular speed – average speed

It is hard to measure regular speed practically. If we observe of a car moving on a road, we find that its speed changes according to traffic; it does not stay constant. In this case the movement of the car is described as «movement at irregular speed».

In this case, it is useful to refer to another term which is the average speed ($\overline{V}$) known as the total distance that a moving object covers divided by the total time taken to cover this distance. This means that:

$$\text{Average speed} (\overline{V}) = \frac{\text{total distance covered}}{\text{total time}}$$



▲ Figure (5): The car's speed changes according to traffic.

In symbols it is

$$\overline{V} = \frac{d}{t}$$

Question for thinking

- What is the thing that moves at constant speed in space?

- Average speed represents the regular speed by which the object moves to cover equal distances at same period of time.
- When the objects moves with a uniform speed, the average speed of the object = its unifrom speed ($V = \overline{V}$),
- **The speed is called non uniform** when the object covers equal distances at unequal of periods of time or covers unequal distances at equal periods of time.

solved Example :

A runner covered a distance of 100 meters of a straight track in 10 seconds. Then, he returned back walking. He took 80 seconds to come back to the starting point of running.

The racer's average speed while running is calculated by this relation:

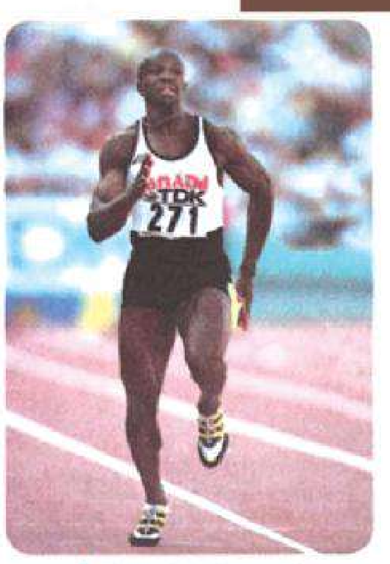
$$\bar{V} = \frac{d}{t} = \frac{100}{10} = 10 \text{ meter / second}$$

His average speed while returning is:

$$\bar{V} = \frac{d}{t} = \frac{100}{80} = 1.25 \text{ meter / second}$$

The racer's average speed during the whole trip is:

$$\bar{V} = \frac{d}{t} = \frac{200}{90} = 2.22 \text{ meter / second}$$



▲ Figure (6): Arunner in a 100 meters race.

Relative speed

If there is a person in a car that moves at 80 kilometers in a certain direction. Then, a car moves at 90 kilometers passed him in the same direction. This means that if there is a person standing on the side of the road and he observes the speed of the moving cars (this person is called the observer).

Therefore:

- The speed of the slow car relative to the observer standing on the ground = 80 kilometers /hour
- The speed of the fast car relative to the observer standing on the ground = 90 kilometers/ hour.
- As for the fast car relative to the passenger in the slow car is 10 kilometers/hour
- Does the value of the car's speed differ in relative to the change in the observer's position? (Yes / No)



▲ Figure (7): The relative speed

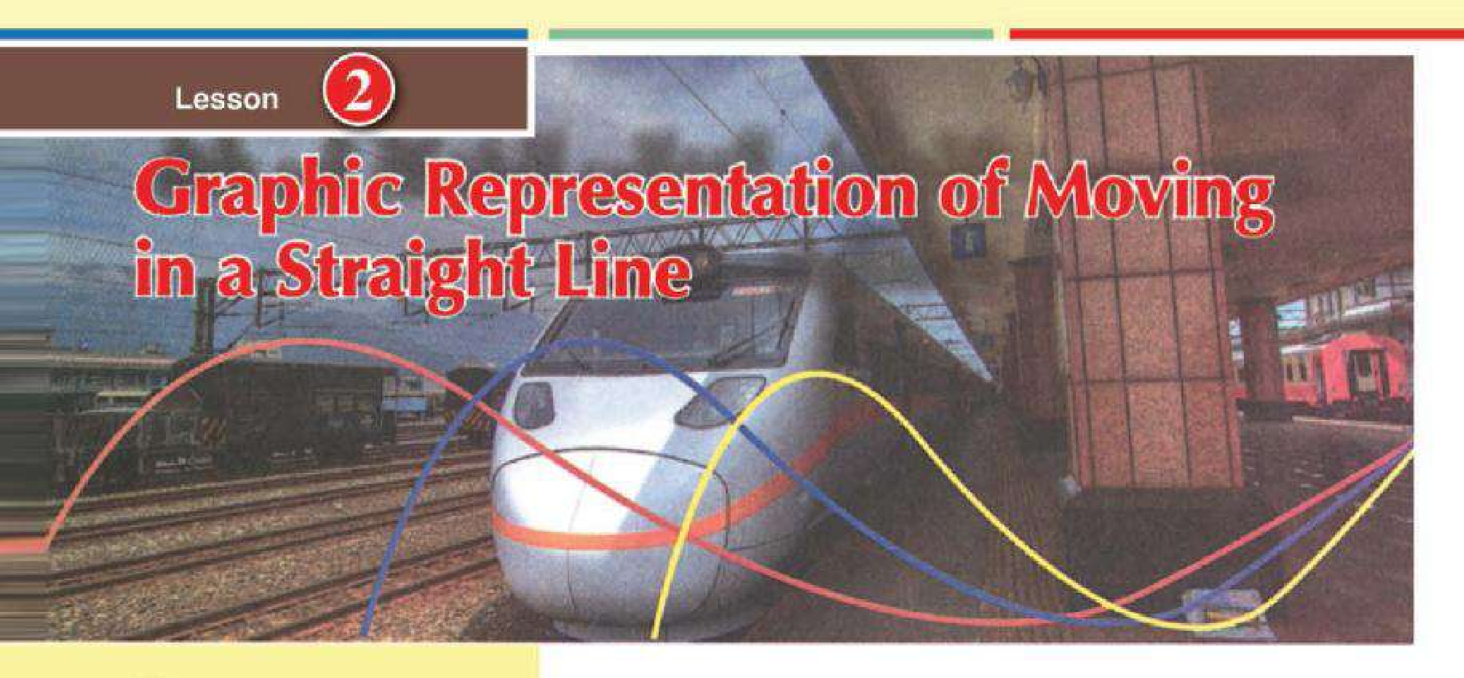
Therefore,

Measuring speeds depends on the position of the observer who determines the magnitude of this speed. This means that relative speed is the speed of the moving object relative to the observer.

We can conclude that:

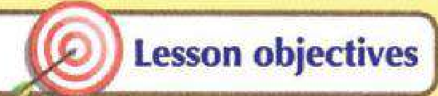
The value of the car's speed relative to the observer standing on the ground differs from the value of the car's speed relative to an observer in another moving car. So, the relative speed depends on the position of the observer. this means that the relative speed is a speed of the moving object relative to the observer.

For extra activities and practice, go to MOE website.



Lesson 2

Graphic Representation of Moving in a Straight Line



Lesson objectives

By the end of this lesson, students should be able to:

- ✔ Draw the graphic relation (distance - time) of a moving object at regular speed.
- ✔ Draw the graphic relation (speed - time) of moving object at irregular speed.
- ✔ Identify the concept of acceleration.
- ✔ Distinguish between increasing and decreasing accelerations.



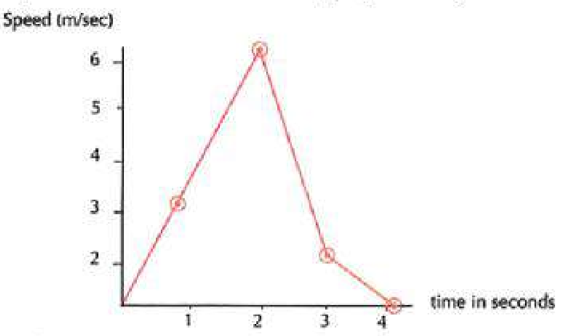
Lesson terms

- Acceleration.

To understand many of the physical phenomena, mathematicians use mathematical relations between different variables to describe a specific phenomenon. As for physicists, they use mathematical methods like graphs and tables to predict the relation between certain physical quantities, understand practical results and describe the physical phenomena in an easier way.

For example, graphics can possibly represent the relation between the speed and time of a moving car.

If the car starts to move from rest (speed = zero) and after one second its speed becomes 2 m/sec. After another second, its speed increases to 5 m/sec. Then, the motorist had to use the brakes to slow down the car's speed to 1 m/sec in the third second and he stops completely after another second. It is possible to represent the movement graphically as the following:



▲ Figure (8): The graphic relationship (Speed - Time) of a car motion.



Representing the uniform speed graphically

Tools:

A toy car operated by a battery – smooth wooden board of about 2 meters length – a metric ruler or metric strip – stop watch

Procedures:

Collaborate with your classmates to do the following activity:

1. Place the wooden board at a horizontal position. Put two marks at a certain distance on the wooden board as in figure (9). Measure the distance between them (d).



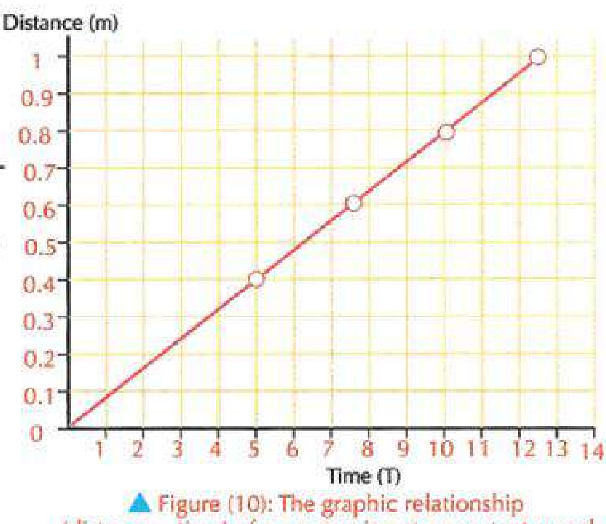
Figure (9) The relation between distance and time

2. Operate the car, and during that, another student measures the time (t) taken to cover this distance.
3. A third student repeats the experiment changing the two marks.
4. Exchange the tools with your colleagues and repeat the experiment.
5. Write the results in a table.
6. In each time, calculate the speed of the car from the relation: V= d/t.

The following table illustrates some readings that a group of students made:

The number of trial	The covered distance (d) meter	The time taken to cover the distance (t) second	The speed V = d/t m/s
1	0.4	5	0.08
2	0.6	7.5	0.08
3	0.8	10	0.08
4	1.0	12.5	0.08

To illustrate the relation between distance (d) and time (t), we can draw a graph of the measured quantities. We use the distance (d) on the vertical axis (Y-axis) and time on the horizontal axis (X-axis) as in figure (10). Then, we place the readings in the table in the shape of dots. When we join these dots together, we find that they are located on a straight line passing the intersection point of the two axes. (the origin point).The resulting graphic line represents the car motion



▲ Figure (10): The graphic relationship (distance – time) of a car moving at a constant speed



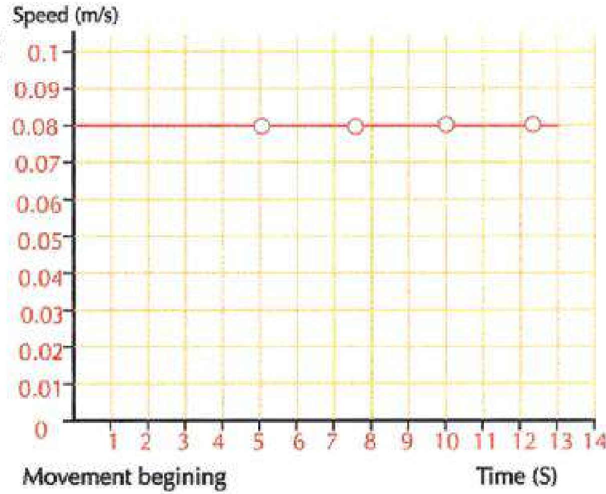
Study the previous (distance - time) graph and conclude:

What is the proportional relation between distance (d) and time (t)?

Does the car move at a uniform speed? (Yes/ No)

If we draw the relation between the speed (V) and time (t), we get a graphical relation as shown in figure 11.

Use the previous table to draw the graphical relation between the speed (V) and the time (t) which represents the car motion its a regular speed.



▲ Figure (11): the (Speed – Time) graph for a car moving at constant speed (uniform speed)

Study the previous relationship and conclude:

What is the value of the uniform speed of the car? .... meter/second

From the previous activity, some facts are clarified about the regular movement in a straight line.

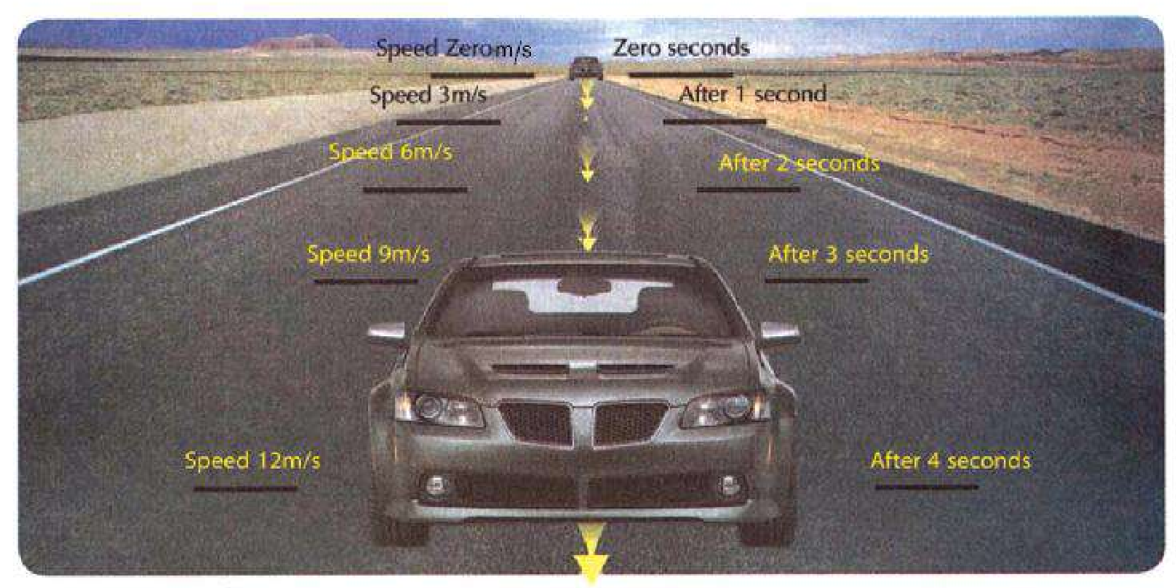
1. The (distance – time) graph for regular motion at constant (uniform) speed is represented by a straight line passing through the origin point.
2. The (speed – time) graph for regular motion at constant (uniform) speed is represented by a straight line parallel to the time axis.

What is the concept of acceleration?

If you sit in a car next to the driver and the car starts moving from rest on a straight road, you notice that the car's speed increases by time. So, after a second the speed equals 3 meters/second.

After two seconds, the speed is 6 meters/second and after three seconds the speed becomes 9 meters/secondAfter four seconds, the speed becomes 12 meters/second.

To describe the movement of the car in this case, we use a physical quantity that expresses the change in the car's speed in one second. We call it "acceleration" As shown in figure (12), the car's speed increases at a constant rate (in a speci fic direction) and in this case the movement is described as "accelerating motion". But, if the car's speed decreases each second until it stops, the movement is described as deceleration . Acceleration is the result of dividing the change in the car's speed (Δ V) by the time (Δ t) in which the change occurs.



▲ Figure (12): What is the value of acceleration that the car move with?

$$\text{Acceleration (a)} = \frac{\text{Change in speed } (\Delta V)}{\text{Time } (\Delta t) \text{ in which change occurs}}$$

The change is represented by the symbol : Δ (delta)

This means that:

$$\text{Acceleration (a)} = \frac{\text{Final speed } (V_2) - \text{initial speed } (V_1)}{\text{Time } (\Delta t)}$$

What is the measurement unit of acceleration?

We previously learnt that the speed measurement unit is meter/second and that time measurement unit is second.

$$\therefore \text{Acceleration units} = \frac{\text{Speed units}}{\text{Time units}} = \frac{\frac{\text{Meter}}{\text{second}}}{\text{Second}} = \text{meter/second}^2$$

- In the previously mentioned example, acceleration is = $\frac{V_2 - V_1}{t} = \frac{12 - \text{Zero}}{4} = 3$ meters / second^2
- If the object's speed increases by time, it is called acceleration.
- If the object's speed decreases by time, it is called deceleration.

This means that acceleration is the value of change of an object's speed in one second.

Question for thinking

- A car whose movement starts from rest and then its speed increases to 15 m/sec through 5 seconds.
- Another car whose movement starts from rest and then its speed increases to 20 m/sec through 10 seconds.
- Which of the two cars is moving at greater acceleration?

Exercise: uniform acceleration

Assume that an object starts its movement from rest and in a straight line and assume that we record its speed every five seconds as in the following table:

Time (t) second	Speed (V) meters/second
0	0
5	10
10	20
15	30
20	40
25	50
30	60

What do you notice in the table?

Does the object's speed increase regularly during movement? (Yes /No)

What is the value of increase in the object's speed every five seconds? ....

Calculate the value of increase in the object's speed every second? ....

What is the value of the object's acceleration during this time(30 S.)? ....

In this case, we say that the object moves at a uniform acceleration. Uniform acceleration means that the object's speed changes (increases or decreases) by equal values through equal periods of time.

Example:



▲ Figure (13): A bus moving in a straight line .

On a straight line there is a moving bus whose speed changes from 6 meters/second to 12 meters/second during a period of three seconds, what is the value of acceleration?

Initial speed = V_1 = ... m/s

Final speed = V_2 = ... m/s

Time = ... s.

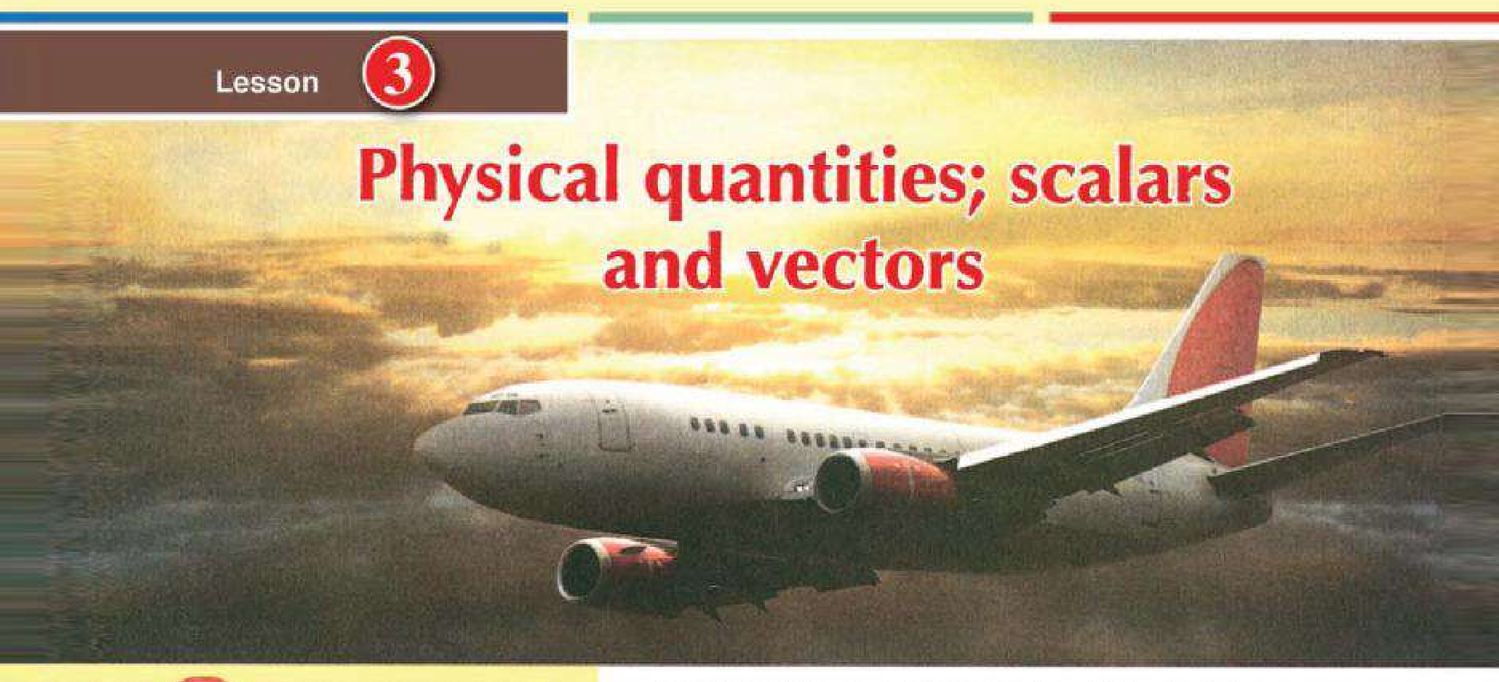
Acceleration = $\frac{V_2 - V_1}{t}$ = $\frac{... - ...}{... - ...}$

= .... m/s^2

For extra activities and practice, go to MOE website.

Lesson 3

Physical quantities; scalars and vectors

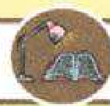




Lesson objectives

By the end of this lesson, students should be able to:

- ✔ Identify the concept of physical quantities.
- ✔ Mention examples of some standards and vectors physical quantities.
- ✔ Compare between distance and displacement.
- ✔ Identify the concept of a velocity



Lesson terms

- Standards physical quantities.
- Vectors physical quantities.
- Displacement.
- Velocity.

The description and interpretation of physical phenomena represent the greatest part of physics. To understand these phenomena, it is necessary to deal with physical quantities and mathematical relationships . Each physical quantity is related with a measurment unit that characteristic to it Examples of physical quantities are: mass – length – time – force – Velocity - displacement - acceleration



▲ Figure (14): Time is an example of physical quantities

Mention other examples of physical quantities:

.... , ... ,
.... , ...

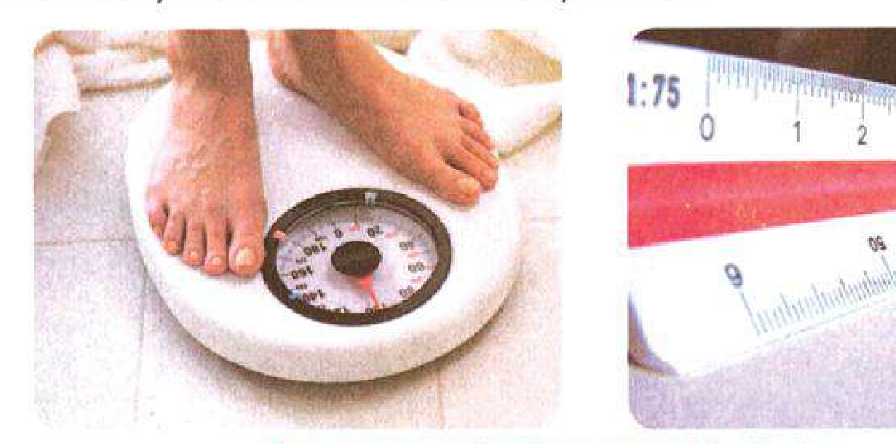
All physical quantities are classified into two types:

1. Scalars.
2. Vectors.

What are the Scalar's physical quantities

To define the scalar physical quantity, it is enough to identify its magnitude only by giving its numeric value and measurement unit.

Examples of scalar's physical quantities are mass (measured by kilogram), length (measured by meter) and time (measured by second).



▲ Figure (15): Length and mass are examples of scalars

This means that the scalar quantity is the quantity that has magnitude only and it has no direction.

Mention some other examples of scalars:

.... , ... , ...

Why are these scalars?

....

Information

Enriching information

- All scalars are subject to algebraic mathematical operations related to numbers and specially they are added and subtracted if they have the same measurement units.

What are vector physical quantities?

To define vectors, it is not enough to identify their magnitudes only by giving their numeric value and measurement unit but also a direction as well.

Quantities needed to identify their magnitudes as well as directions are called vectors.

Examples of these vectors are: force, acceleration, velocity and displacement.

Mention some other examples of vectors:

.... ، .... ، ....

Why are these vectors?

....

Information

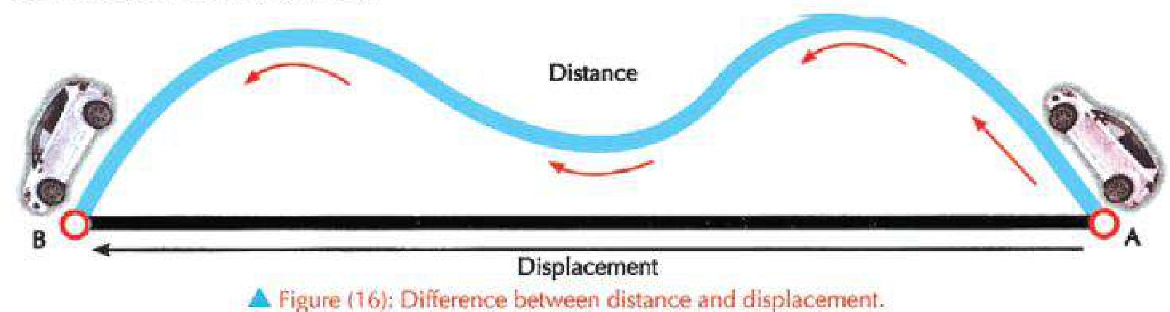
Enriching information

- All vectors are subject to mathematical operations called vectors algebra. Vectors have a great importance in different fields of physics and applied sciences like engineering. Understanding various physical phenomena such as gravity, movement of liquids and geometrical establishments depends basically on the main properties of vectors.

Distance and displacement

When a position of an object changes within a period of time, this means that the object has moved. This change in the position that accompanying the object does not depend on the path of the moving object but it depends on the shortest path between the start position and the end position where the object stops.

If an object moves from position (A) to position (B) as shown in figure (16), the change in its position is represented by the straight line that starts at point (A) and ends at (B) in the direction from (A) to (B).



▲ Figure (16): Difference between distance and displacement.



▲ Figure (17): The distance difference between Cairo, Benha and Tanta.

Exercise:

What is the difference between distance and displacement?

If a person wants to make a trip by car to Tanta starting from Cairo, the distance between Cairo and Tanta depends on the length of the path that the car takes as in figure (17).

Study the previous map and then answer the following questions:

1. If the trip's path is: Cairo – Benha, tanta how long is the covered distance?
   .... Kilometers.
2. If the trip's path is: Cairo – Zagazig - Tanta, how long is the covered distance?
   .... Kilometers.
3. We notice that there is a difference in the value of distance although the two cities Cairo and Tanta are constant.
4. If we assume that the trip between Cairo and Tanta is made directly, the direct distance between them is 93 kilometers in a direct line.

In this example:

Cairo represents the start of the trip while Tanta represents the end. Direct movement from Cairo to Tanta represents the change in the position of the moving object. The path (Cairo – Zagazig – Tanta) represents the **distance** of a possible movement. Also, the path (Cairo – Benha – Tanta) represents another distance of a possible movement.

Question for thinking

- When is the distance identical to the amount of displacement?

As for the straight (direct) distance whose start is Cairo and its end is Tanta represents the **displacement** of the car when reaches Tanta from Cairo. Displacement is characterized by both the magnitude and direction. The displacement of Tanta from Cairo = 93 kilometers in the western north direction.

What is meant by displacement?

Displacement is the length of the shortest straight line between two positions.

What is meant by a direction?

It is from the primary position of movement towards its final position.

Displacement is the covered distance at a certain direction and it is a vector, but distance is the actual length of the path that a moving object takes from the starting point of movement to the end point.

Information

Enriching information

- Two equal displacements have the same magnitude and the same direction

Velocity

There is a difference between the speed and the velocity.The velocity it is the speed in a given direction To determine the velocity we must know the value of the speed and its direction. The predator animal (cheetah) is one of the fastest animals, where its speed reaches 27 m/second. If we want to represent its velocity, we should define the direction of its movement. We say for example that cheetah's velocity = 27meters/second in the west direction.

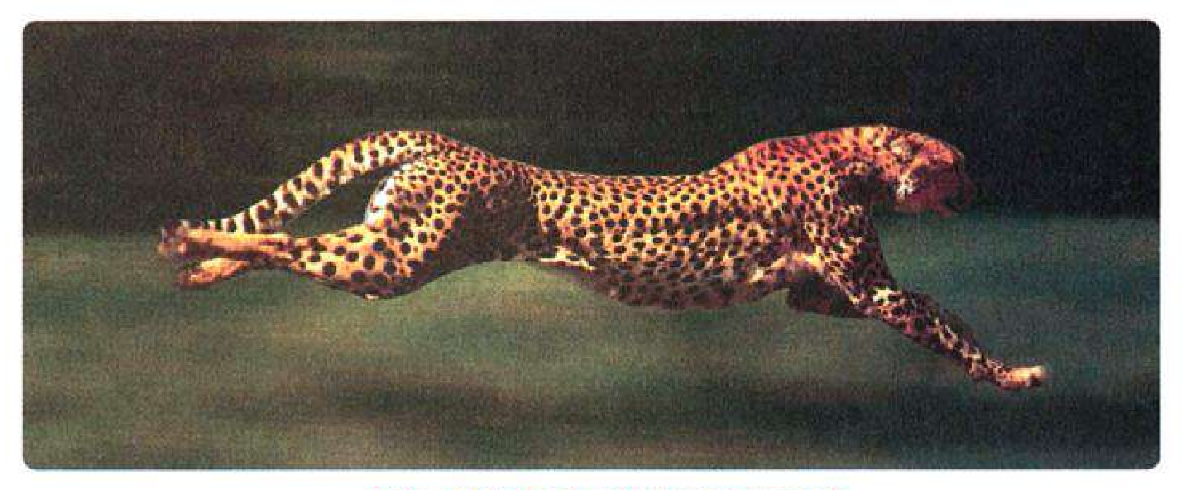


Figure (18): The cheetah is the fastest animal.

How can we calculate the Velocity?

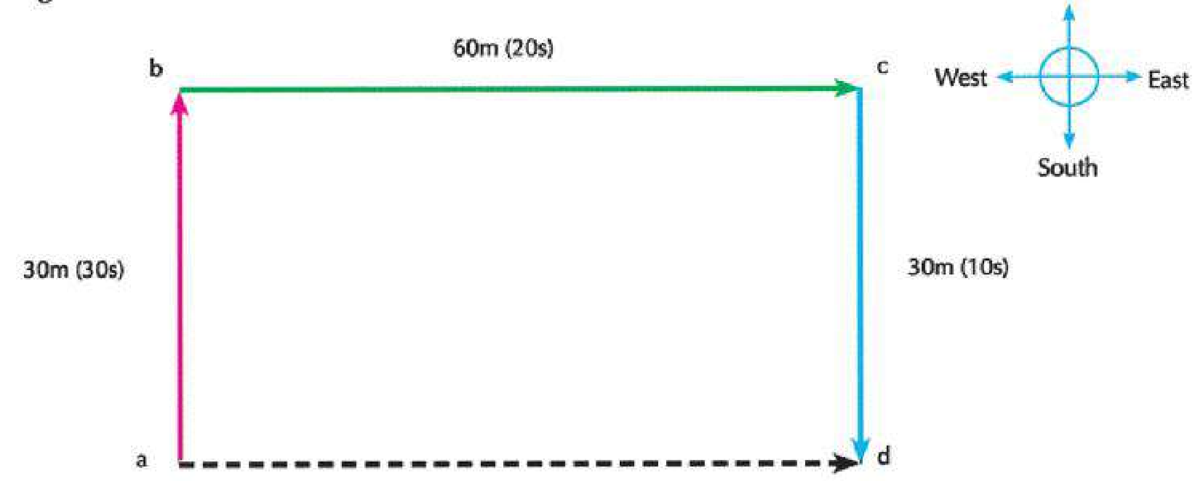
Based on previous observations, the velocity is a vector quantity. To determine it accurately, it is necessary to identify its magnitude and direction. Calculating the average velocity can be done through the following relationship:

$$\text{Velocity} = \frac{\text{Displacement}}{\text{Total time}}$$

This means that the velocity is the displacement in one second. It is a vector that has the same speed units (meter / second or kilometer / hour).

Solved Example:

A person covered 30 meters northward within 30 seconds, then 60 meters eastward within 20 seconds, and then 30 meters southward within 10 seconds as shown in the figure.



Assume that the path the person took is a ⟶ b ⟶ c ⟶ d

1. What is the start point of movement? (a)
2. What is the end point of movement?. (d)
3. What is the value of total distance that the person covered?. 30+60+30=120m
4. What is the value of total time that the person took to cover this distance?. 30+60+10=60 sec
5. What does the direction line between point (a) and (d) in the direction from (a) to (d) represent? straights

∴Displacement = 60 meter in the east direction.

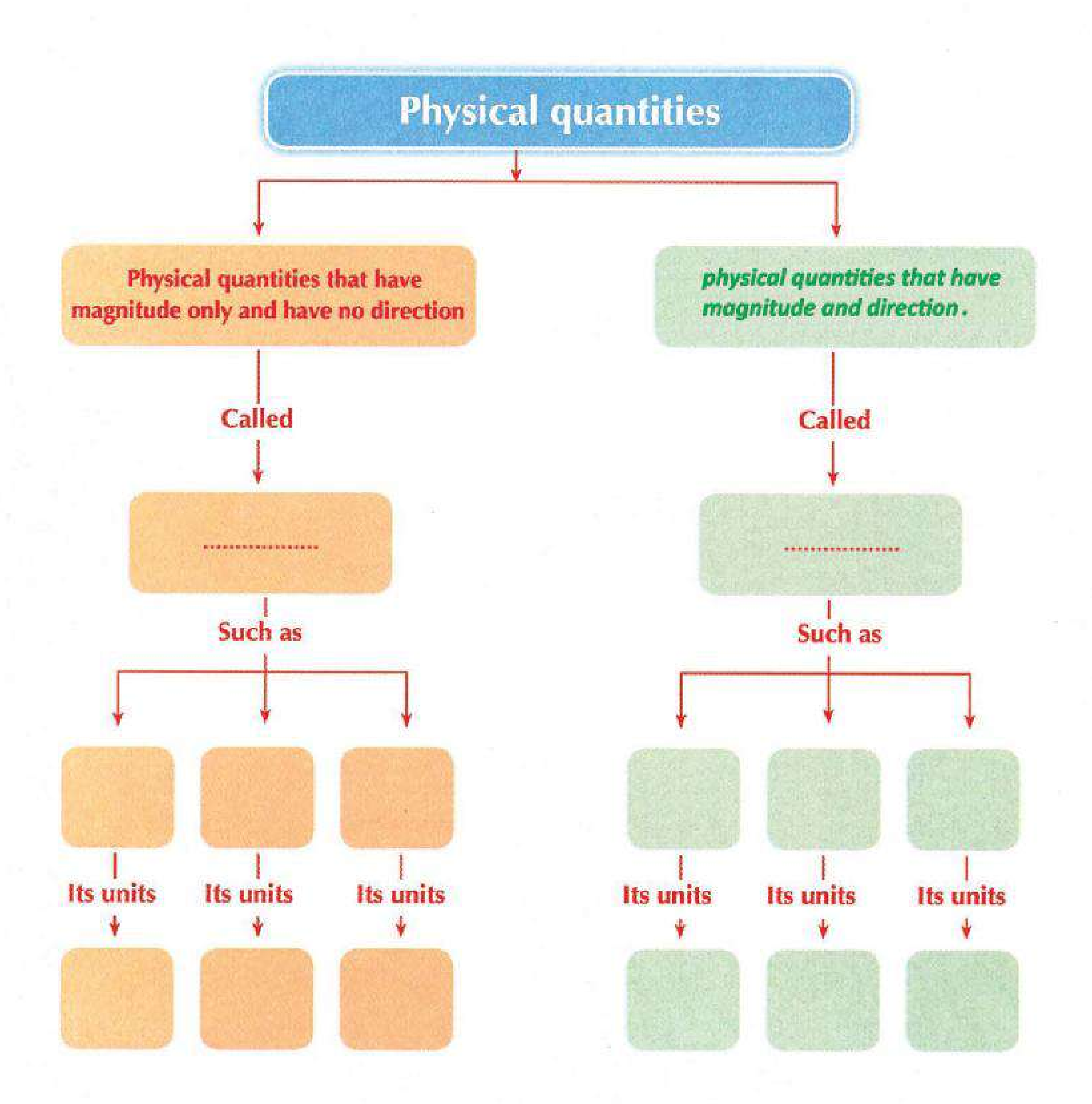
Calculate the velocity:

The average velocity = $\frac{60}{60}$ = 1 meters/second in the direction of east

For extra activities and practice, go to MOE website.

Exercise: scalars and vectors

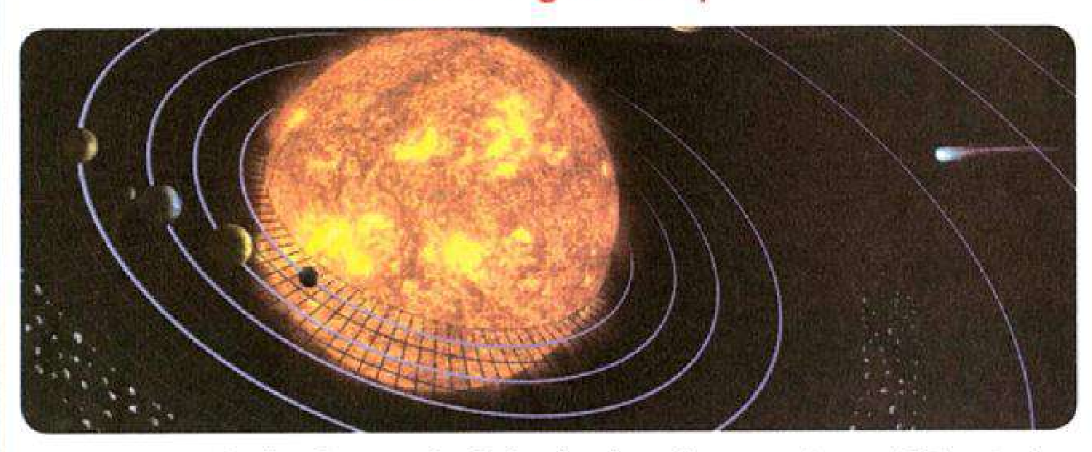
Complete the flow of concepts:





Science, Technology and Society

Enriching activity



How can you calculate the time that light takes from the sun to the earth? To calculate this time, we take into consideration that light travels at constant regular speed in space.

The relationship of : $V = \frac{d}{t}$ can be applied to calculate time by knowing the speed of light and the distance between the earth and the sun as follows:

If the sun is 149000,000 kilometers away from the Earth and if the speed of light is 300,000 Km/s.

To calculate the time that light takes from the sun to reach the Earth the sun we assume that reach the sun sets at five o'clock in the evening. At what time did the sunlight travel in the direction of the Earth?

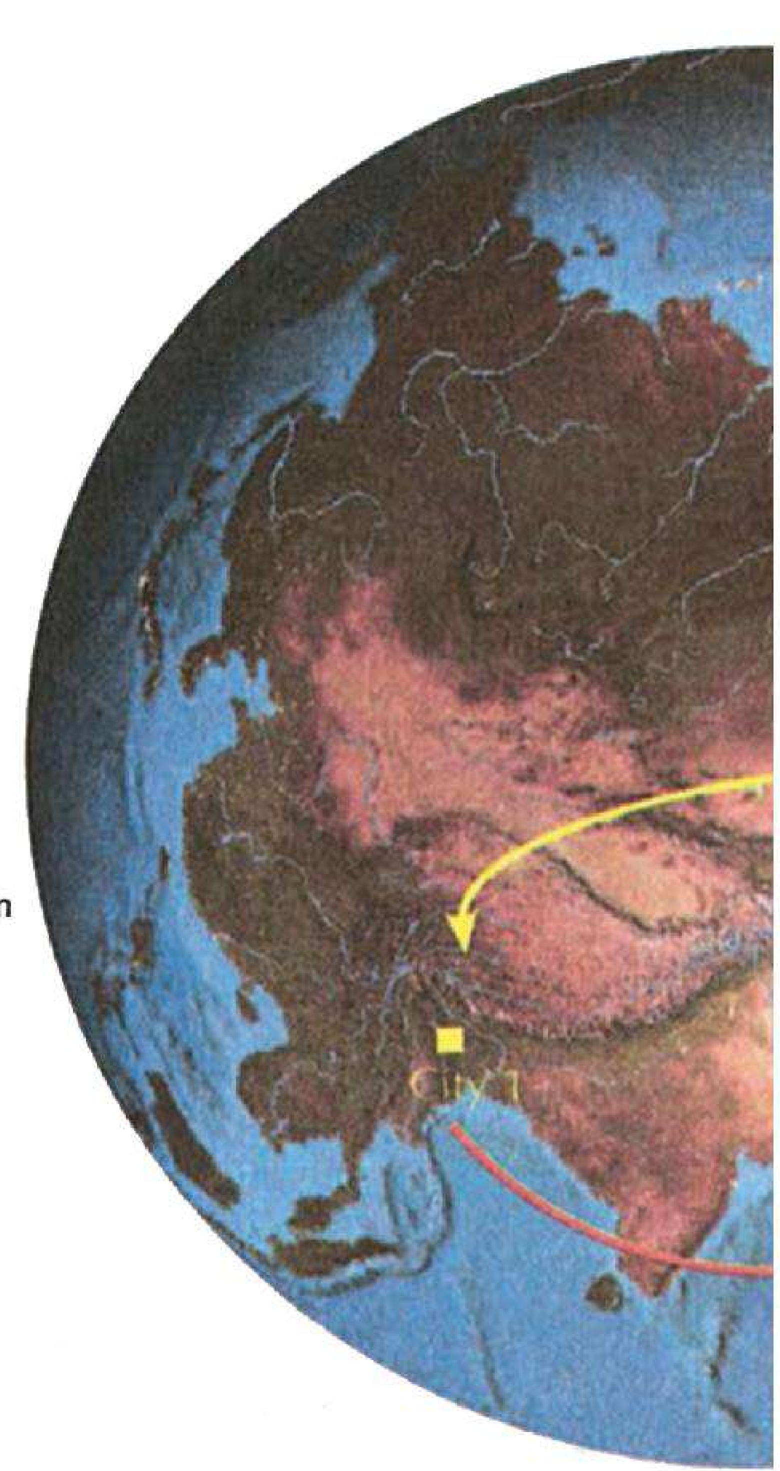
To calculate this time, we use the concept of speed noticing that the light speed is constant. This means that light travels at regular speed that can be determined through the following relationship:

$$\text{Speed of light} = \frac{\text{Total distance covered}}{\text{Total time}}$$

$$\text{Time} = \frac{\text{Total distance covered}}{\text{light speed}} = \frac{149000000 \text{ kilometer}}{300000 \text{ kilometer/second}} = 497 \text{ Second approximately} =$$

8 minutes and 17 seconds.

If the time of sunset is five o'clock it is determined that light travelled from the sun at four o'clock and fifty one minutes and thirty three seconds

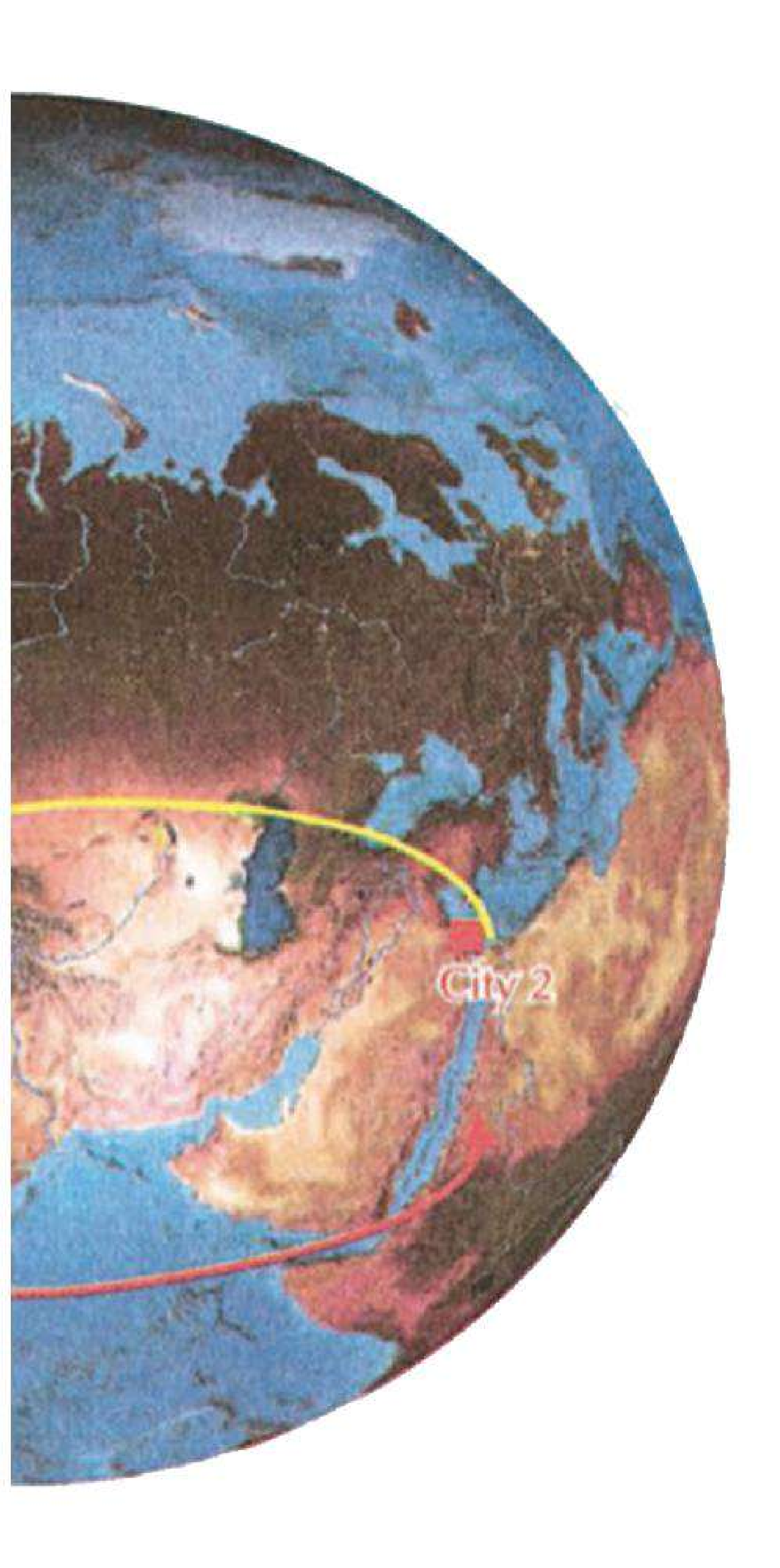


Technological application

On their flights, pilots take into consideration the velocity of the wind in order to calculate the amount of fuel necessary to complete the trip.

The Earth spins in a complete rotation every 24 hours. The movement of the Earth results in the movement of winds above its surface.

If we assume that a plane flew from city (1) to city (2) and at the same time a plane flew from city (2) to city (1),

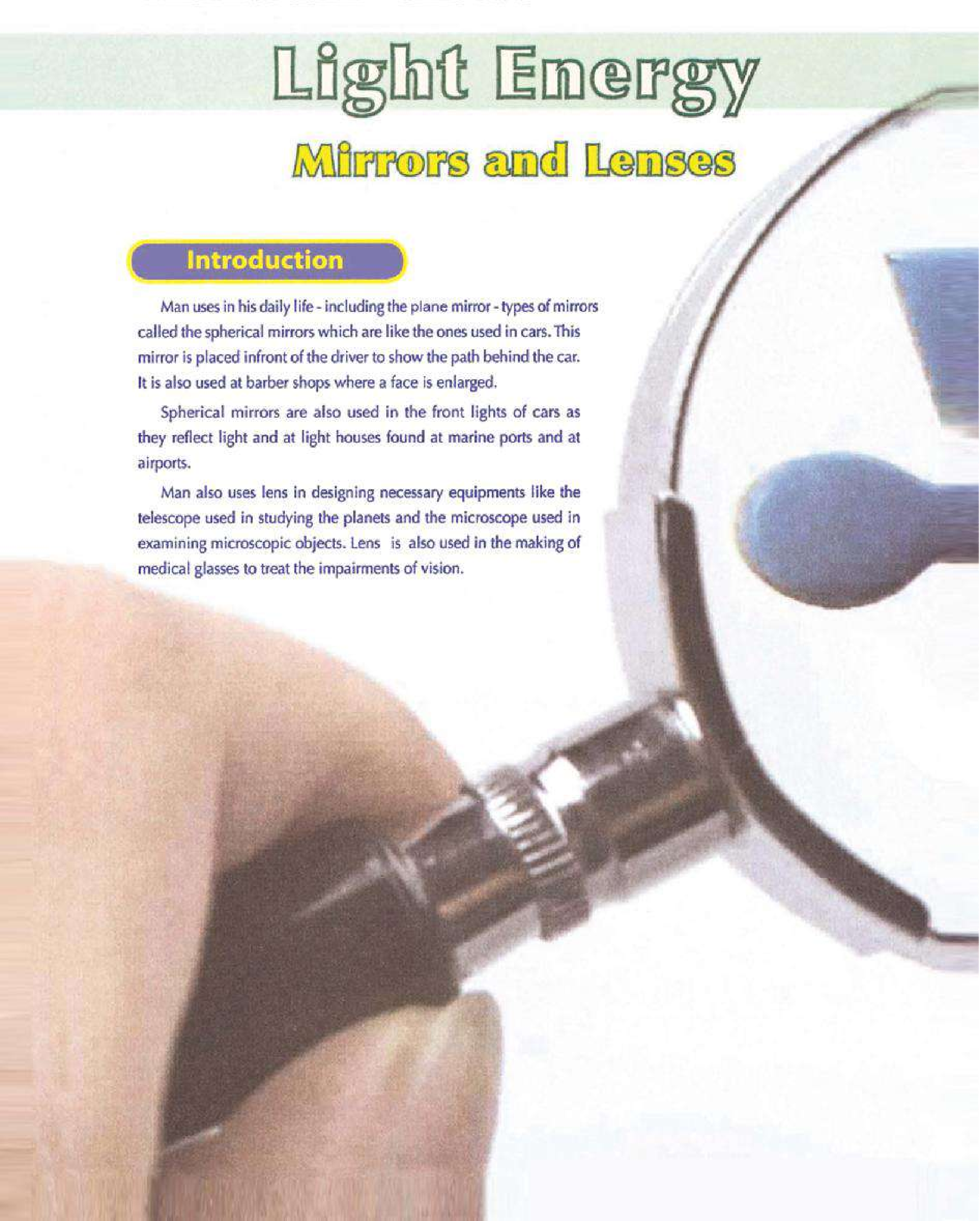


The first plane flying from city (1) to city (2) takes a longer time than the second plane from city (2) to city (1). This is because the first plane flies in the opposite direction of the wind and consequently wind resistance is greater. So, it needs larger amount of fuel than the second plane although the covered distance is constant for each of the two planes.

The first term - Unit two

Light Energy

Mirrors and Lenses

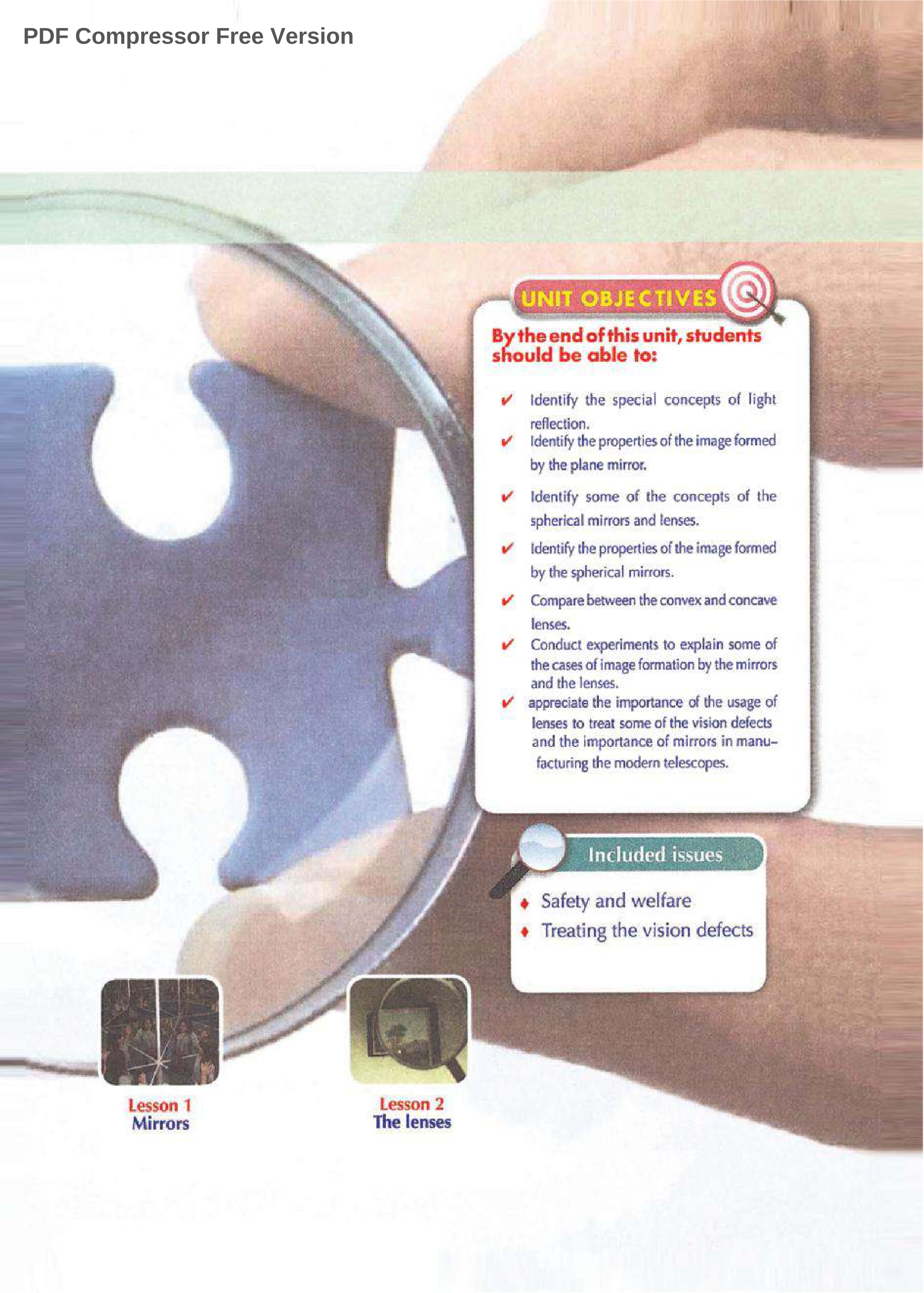


Introduction

Man uses in his daily life - including the plane mirror - types of mirrors called the spherical mirrors which are like the ones used in cars. This mirror is placed infront of the driver to show the path behind the car. It is also used at barber shops where a face is enlarged.

Spherical mirrors are also used in the front lights of cars as they reflect light and at light houses found at marine ports and at airports.

Man also uses lens in designing necessary equipments like the telescope used in studying the planets and the microscope used in examining microscopic objects. Lens is also used in the making of medical glasses to treat the impairments of vision.


UNIT OBJECTIVES
By the end of this unit, students should be able to:
✔ Identify the special concepts of light reflection.
✔ Identify the properties of the image formed by the plane mirror.
✔ Identify some of the concepts of the spherical mirrors and lenses.
✔ Identify the properties of the image formed by the spherical mirrors.
✔ Compare between the convex and concave lenses.
✔ Conduct experiments to explain some of the cases of image formation by the mirrors and the lenses.
✔ appreciate the importance of the usage of lenses to treat some of the vision defects and the importance of mirrors in manufacturing the modern telescopes.
Included issues
♦ Safety and welfare
♦ Treating the vision defects
Lesson 1
Mirrors
Lesson 2
The lenses

Lesson 1

Mirrors

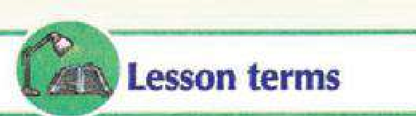




Lesson objectives

By the end of this lesson, you should be able to:

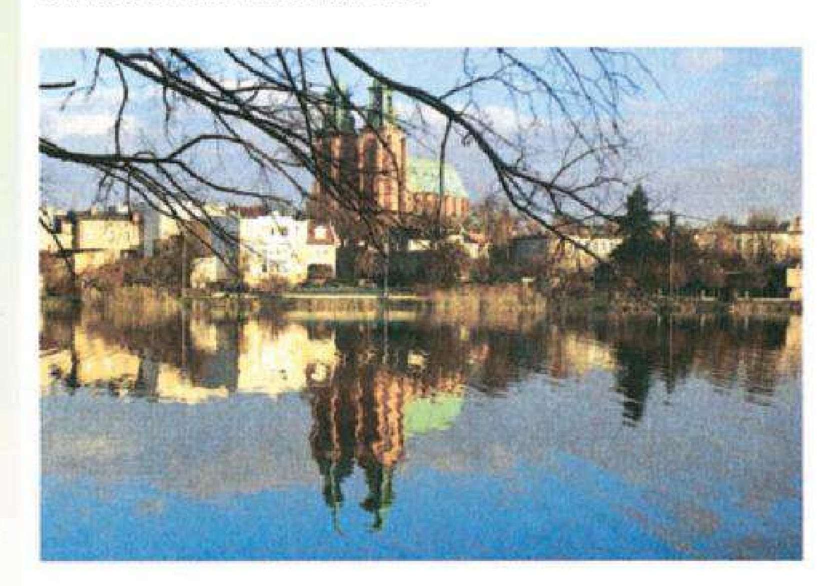
- ✔ Identify the reflection of light.
- ✔ Identify the two laws of light reflection.
- ✔ Identify the properties of the image formed by the plane mirror.
- ✔ Identify the two types of spherical mirrors.
- ✔ Identify some of the concepts of spherical mirrors.
- ✔ Identify how the images are formed in the spherical mirrors and their properties.
- ✔ Conduct experiments to show some cases of image formation on the spherical mirrors.



Lesson terms

- Cancave and convex mirrors
- The real and virtual image
- Principle and secodary axis

The human being noticed that when he looked at the still water surface, he could see an image of his face in the water, and he also noticed the images of the high buildings that are constructed near the still water. Moreover, if you look at the shinning smooth surface (like the mirror) you can see an image of your face. All this happens as a result of the reflection of light (its bouncing off) on the water surface or the mirror surface.



▲ Figure (1): The image of the buildings on water surface as a result of the light reflection.



The properties of the image formed by the plane mirror

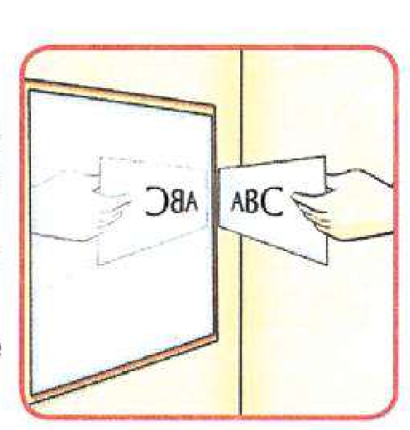
The material:

A plane mirror – a card with some letters written on it.

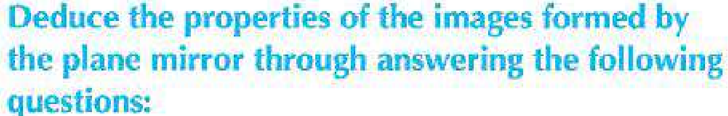
The steps:

Collaborate with your colleagues to accomplish this activity by preparing a white carton paper and writing some alphabet letters on it.

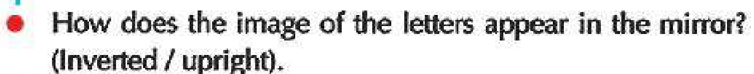
1. Place the card in front of the mirror that is fixed vertically.
2. Record your observation about the properties of the image formed in the plane mirror.



▲ Figure (2): The image reflects in the plane mirror.



Deduce the properties of the images formed by the plane mirror through answering the following questions:



- How does the image of the letters appear in the mirror? (Inverted / upright).



- How does the size of the letters appear in the mirror? (enlarged / smaller/ equal).
- Does the image of the letters in the mirror appear inverted? (Yes / No).
- Can you receive the letters formed in the mirrors on a screen? (Yes / No).
- Did you observe that the distance of every letter to the mirror is equal to the distance of its image to the mirror? (Yes / No).

From the previous activity, you will find that the properties of the image of the objects formed by the plane mirror are as follows:

1. The image is upright.
2. The image is equal to the object.
3. The image is laterally inverted. (reversed)
4. The image is a virtual image (cannot be received on a screen)
5. The distance of the object to the mirror = the distance of its image to the mirror. (The straight line connecting the object and its image is perpendicular on the surface of the mirror).



▲ Figure (3): The word «ambulance» is laterally inverted, why?

Does the light reflection abide to laws?

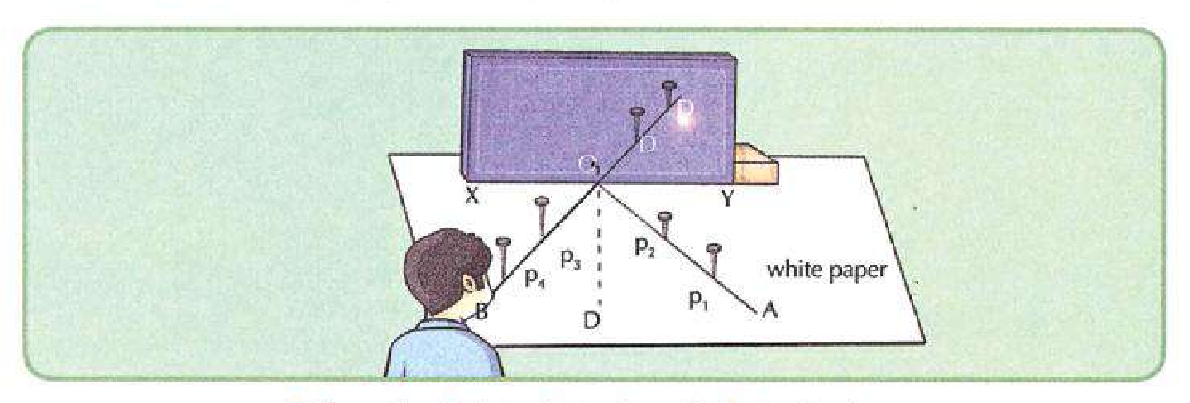
To answer this question, you will conduct the following activity:



The two laws of light reflection

Materials:

A plane mirror – white paper sheet – pins - protractor - ruler



▲ Figure (4): Achieving the two laws of reflection in mirrors

Steps:

1. Draw a straight line (xy) on the white piece of paper, then place the plane mirror in a perpendicular position where the edge of the reflective surface aligns on the line (XY).
2. Draw a line (OD) perpendicular on the line (xy). This line is called the normal.
3. Draw a straight line (AO), which represents the incident light ray on the mirror. makes an angle with the normal (angle of incidence) and place two pins (p_1) and (p_2) horizontal on the line.
4. Look at the other side of the mirror and see the images of the pins (p'_1) and (p'_2), and place two pins (p_3) and (p_4) to be as straight as the images of (p'_1) and (p'_2).
5. Lift the two pins (p_3) and (p_4) and connect between their positions with a straight line extending it until it meets the reflecting surface at point (O). This line (BO) represents the reflecting ray.
6. Measure the angle that (BO) makes with the normal, and this is the angle of reflection
7. Repeat these steps by changing the value of incidence angle by using the protractor and assign the reflection angle each time.

Does the angle of incidence = the angle of reflection? (Yes / No)

The Results

Laws of the reflection of light:

1. **First law: angle of incidence = angle of reflection.**
2. **Second law: The incident light ray, the reflected light ray and the normal line all lie in the same plane perpendicular to the reflecting surface.**

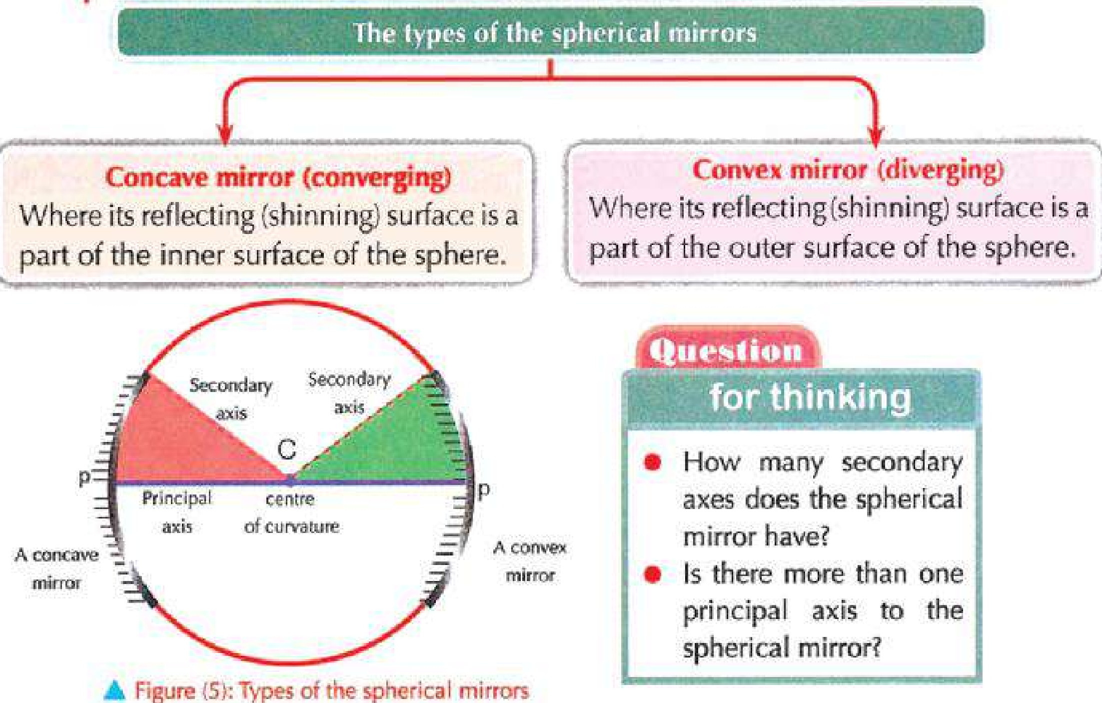
Concepts concerning reflection of light:

- Light reflection phenomenon : is the bouncing the incident light ray in the same medium when it strikes a reflecting surface.
- The incident ray: it is the light ray that falls on the reflecting surface.
- The reflected ray: it is the light ray that bounces from the reflecting surface.
- Angle of incidence: it is the angle between the incident ray and the prependicular line on the reflecting surface from the point of incidence.
- Angle of reflection: it is the angle between the reflected light ray and the prependicular line on the reflecting surface from the point of incidence.

The spherical mirrors

What is the spherical mirror?

It is a mirror that its reflecting surface is a part of a hollow sphere, and there are two types of the spherical mirrors.



▲ Figure (5): Types of the spherical mirrors

Observe figure (5) and identify the concave mirror and the convex mirror.
Study the previous figure and identify the concepts that benefits you when are studying how the image is formed by the spherical mirrors:

- Centre of mirror curvature (C): Is the centre of the sphere that the mirror is considered a part of it.
- Define the position of the centre of curvature of the concave mirror? (in front of the reflecting surface / behind the reflecting surface).
- Define the position of the centre of curvature of the convex mirror? (in front of the reflecting surface / behind the reflecting surface).
- The radius of curvature of the mirror $(\bar{r})$: Is the radius of the sphere that the mirror is a part of it.

- The pole of the mirror (p): Is the point that is in the middle of the reflecting surface of the mirror.
- The principal axis ($\overleftrightarrow{cp}$): Is the straight line that passes by the pole of the mirror and its centre of curvature.
- The secondary axis : Any straight line that passes by the centre of curvature of the mirror and any point on its surface except the pole of the mirror.

The focus of the concave mirror:

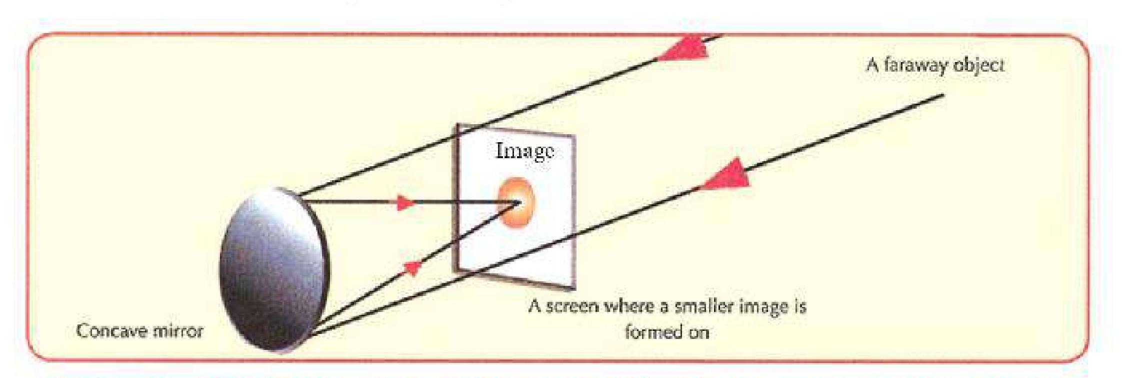
When sun rays or light rays from a distant object falls on the surface of a concave mirror, they are reflected from it and collected at one point called "the focus of the mirror".



Determine the focal length of the concave mirror.

The materials:

A concave mirror - screen - graduated tape (meter).



▲ Figure (6): If the object is very far, the light rays that fall on the concave mirror is almost parallel.

The steps:

1. Place a concave mirror facing the sun ray (or a faraway object)
2. Move the screen in front of the reflecting surface of the mirror to obtain the smallest and clearest image (lit point), it is "the focus of the mirror" (fig.6).
3. Measure the distance between the lit point and the pole of the mirror, this distance is the focal length (f) of the concave mirror.

Conclusion:

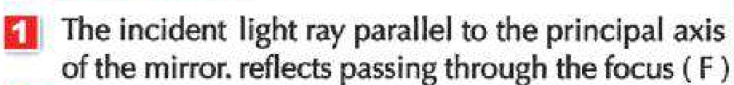
- Did the rays after being reflected from the concave mirror collect in one point that can be received on a screen (Yes / No).
- The point of the collection of the parallel rays after being reflected from the concave mirror is called ....
- The distance between the focus of the concave mirror and its pole is called..............................

We will see that: focal length = 1/2 × radius of curvature

$$(f) = \frac{1}{2} R$$

The image formed by the concave mirror:

To study the cases of the formation of the images by the spherical mirrors, we will use three rules to determine the direction of the reflecting light rays incident on the concave mirror:

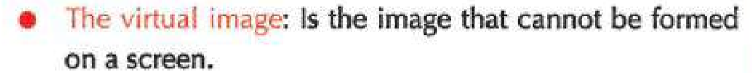


1. The incident light ray parallel to the principal axis of the mirror. reflects passing through the focus (F)
2. The incident light ray passing the through focus(F) will reflect parallel to the principal axis.
3. The incident light ray passing through the centre of curvature of the mirror reflects back on itself.

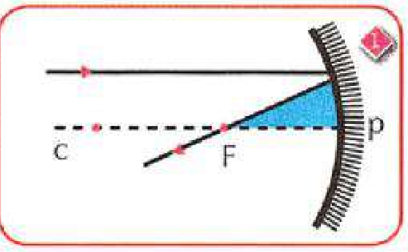
When you place an object in front of a concave mirror you can determine the position of the image of the object and its properties by using only two rays from the previous three rays.

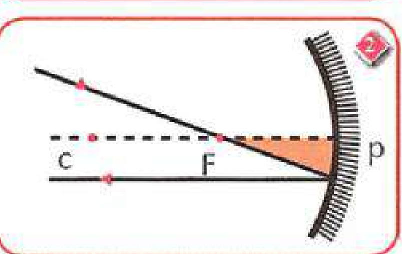


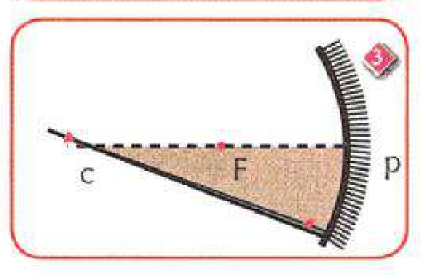
- The real image: Is the image that can be formed on a screen.



- The virtual image: Is the image that cannot be formed on a screen.







▲ Figure (7): The reflection of the incident rays on the concave mirror.

Exercise:

The cases where the images are formed by concave mirror (converge).

To determine the position and properties of the images formed by the concave mirror, follow the following steps:

1. Use the compass to draw a spherical surface and its centre is (c), that represents the concave mirror.
2. Draw the principal axis and determine on it the position of the focus then draw a vertical arrow on the principal axis to represent an object. Determine the centre of curvature where the radius of the sphere equals twice the focal length.
3. Draw a ray from the highest point in the object where it falls parallel to the principal axis and thus reflects passing through the focus.
4. Draw another ray passing through the centre of the mirror curvature then reflects on itself (why does the ray reflect on itself)?.
5. Determine the position where the two reflecting rays meet, which is the image of the highest point of the object.
6. Determine the position and properties of the images formed in the cases shown in the following table, and compare the results you obtain with that indicated in the table.

Position of the object	Position of the images	Properties of the images	The cases of image formation
At a distance greater than the radius of curvature.	Between the focus and the centre of curvature	Real – inverted -diminished	f, c, p, The object, The image
At the centre of curvature of the mirror.	At the centre of curvature of the mirror.	Real – inverted. - equals the object	The object, p, f, c, The image
Between the focus and the center of curvature	At a distance greater than the radius of curvature.	Real - inverted enlarged	The object, f, c, p, The image
At The Focus	At The infinity	The rays exit paralled	c, f, f, c
Between (f) and (p).	Behind the mirror	Virtual-upright magnified	The image, c, f

The formation of the images on a convex mirror:

The image of the object placed in front of a convex mirror is always smaller than the object, upright and virtual (not received on a screen) even if the distance of the object is changed form the convex mirror.





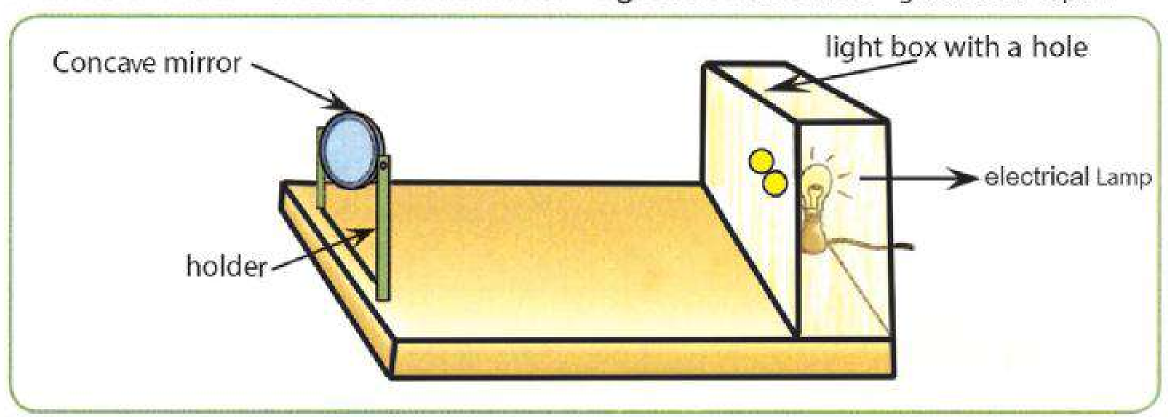
▲ Figure (8): The image that is formed by the convex mirror is virtual, upright and smaller than the object.



Determine half the radius of the concave mirror.

The materials:

A concave mirror – a holder for the mirror – light box with a hole–graduated tape .



▲ Figure (9): To determin the radius of curvature of the concave mirror

The steps:

1. Place the mirror on a holder in front of the light source (lit hole).
2. Move the mirror nearer and farther until an image of the hole is formed next to it and is equal to it.
3. Measure the distance between the mirror and the hole, it is equal to the radius of curvature of the mirror.

Deduce: The focal length of the mirror (f) = R/2

Uses of spherical mirrors

(A) The concave mirror

1- To reflect the emitted light from the front bulbs in cars.

2- In producing the telescopes that monitor the space.

3- The dentist uses them during his work.

4- In magnifying the human face during face caring.

5- In solar oven.

(B) The convex mirror

1- It is placed to the right and left of the cars ' driver.

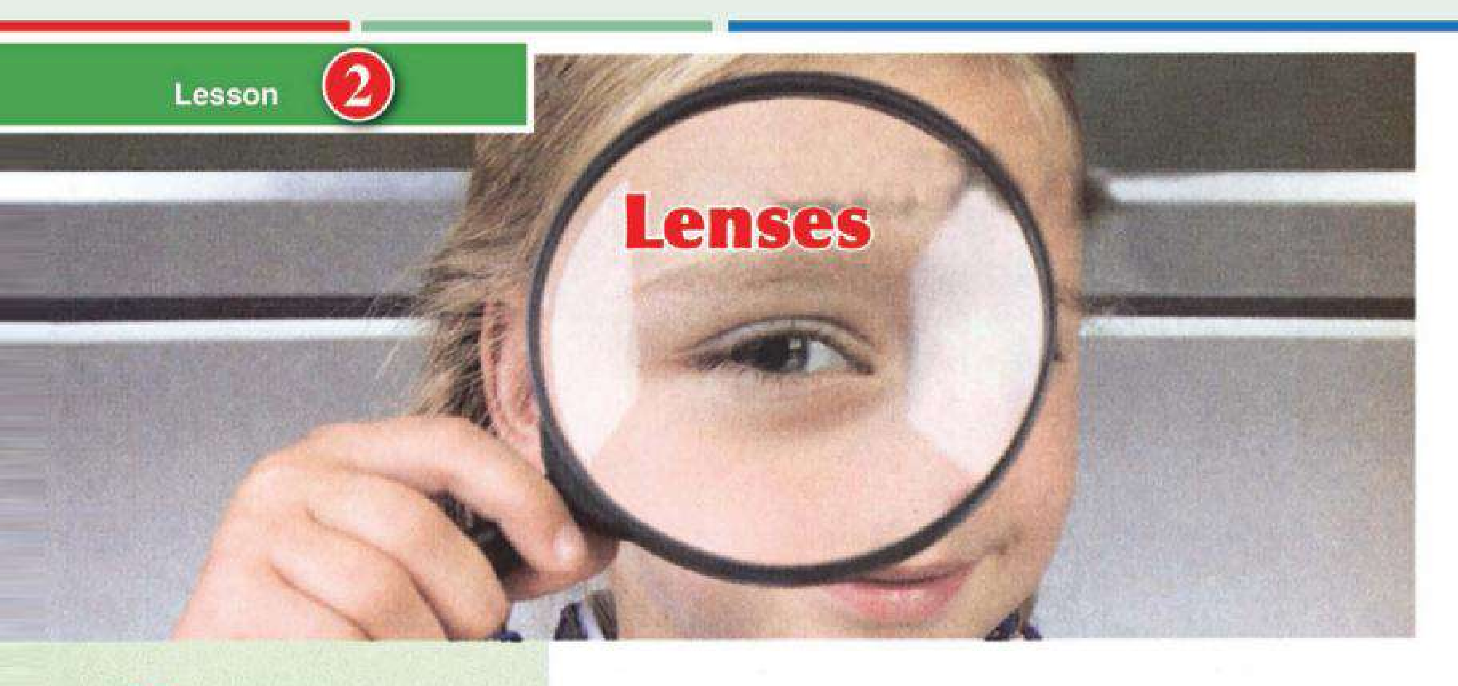
2- It is used at shopping centers that need to high rates of secuirity.

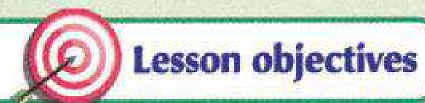
3- It is used at the corners of the narrow roads to monitor the car movement to avoid accidents.

4- It is used at cars ' parking.

5- It is placed on the plateforms of mitro(subway) and railway stations to avoid passenger injury at opening or closing the doors.

For extra activities and practice, go to MOE website.





By the end of this lesson, students should be able to:

- ✔ Identify the types of lenses.
- ✔ Identify the concepts related to the lenses.
- ✔ Identify how the images are formed with the lenses.
- ✔ Do experiments showing some of cases of the formation of the image with the lenses.
- ✔ Identify how to use the lenses in treating some of the vision defects.



- The convex lens
- The concave lens
- The focus of the lens
- Short-sighted
- Long-sighted

You have noticed that many people need the medical eye glasses either for reading or walking. You could see the person who fixes the watches use a magnifier to see the minute parts of the watch. In the war, the leaders use a magnifying glass to follow the battles.

In all these previous cases the human being uses an important optical piece called "the lens".



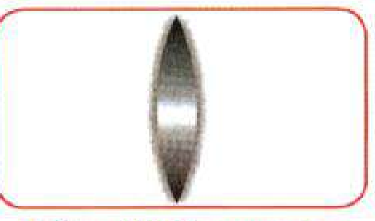

▲ Figure (10): The lenses are used in the manufacture of many things.

What is a lens?

The lens is a transparent medium that refracts the light and is defined with two spherical surfaces and is usually made of glass or plastic.

The types of lenses:

There are a lot of types of lenses we, some of them are:



▲ Figure (11): The convex lens

1 Convex lens (converging):

- It is thick at the centre and less thick at the tips. The function of the convex lens is to collect the light rays falling on it..

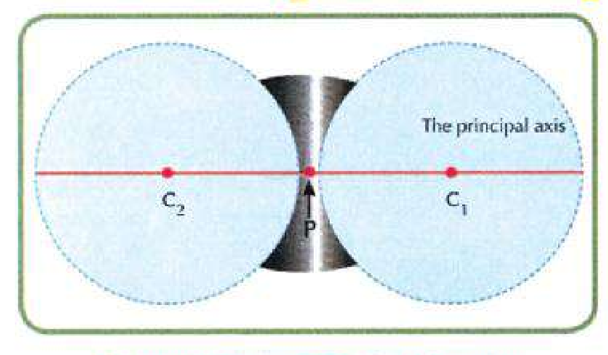


▲ Figure(12): the concave lens

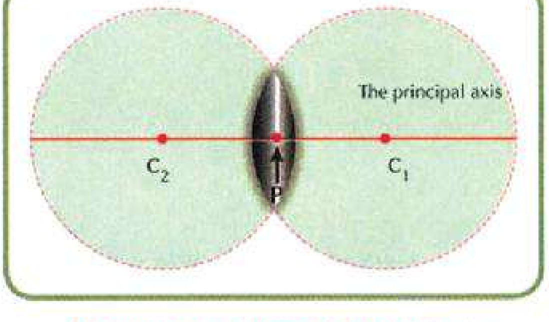
2 Concave lens (diverging)

- It is thin at its centre and more thick at the tips. The concave lens diverges the light rays falling on it.

Special concepts of the lenses



▲ Figure (13): A concave lens (diverging)



▲ Figure (14): A convex lens (converging)

Study the previous figure and identify the following concepts:

1. The centre of curvature of the lens face (c): Is the centre of the sphere where this face is a part of it.

Why does the lens have two centres of curvature?

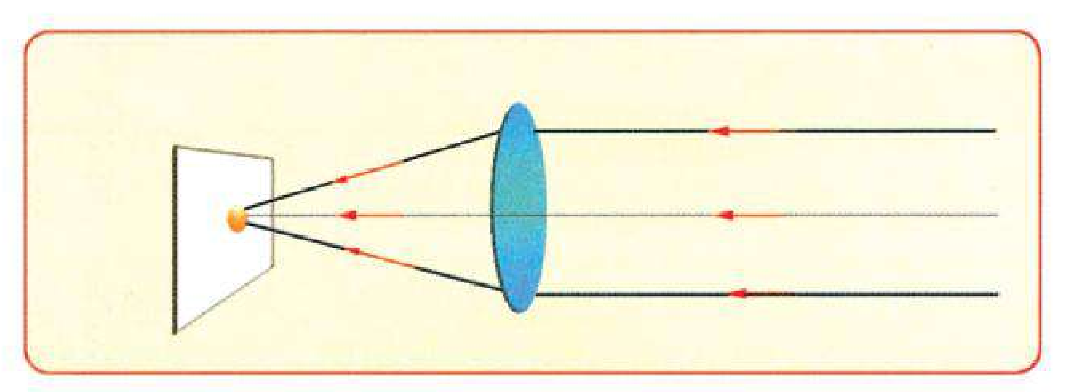
....

2. The optical centre of the lens (p): Is a point inside the lens lies on the principal axis in the mid distance between its faces.
3. The radius of curvature of the face of the lens (p): Is half the radius of the sphere where the face is a part of it.
4. The principal axis: Is the line between the centres of curvature of the lens passing by the optical centre of the lens.

First: The convex lens

The focus of the convex lens (converging):

If the sun rays or any light rays from any distant source fall on the lens we notice that the rays passing through the lens are collected at one point called "the focus of the lens".



▲ Figure (15): The convex lens forms a real, inverted, smaller image of the distance object.



Determination of the focal length of the of light convex lens

Materials:

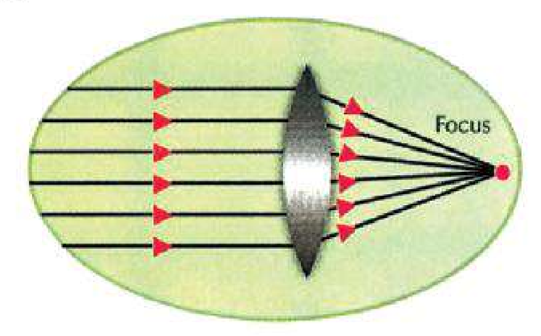
A convex lens – screen – lens holder – distant source of light (can use the sun ray)

The steps:

1. Place the lens on a holder where the distant light source is facing one of its faces.
2. place a vertical screen on the other side of the lens and move it closer and farther from the lens until you get the lit point which is the «focus of the lens».
3. Measure the distance between this point and the optical centre of the lens which is the focal length (f) of the convex lens.



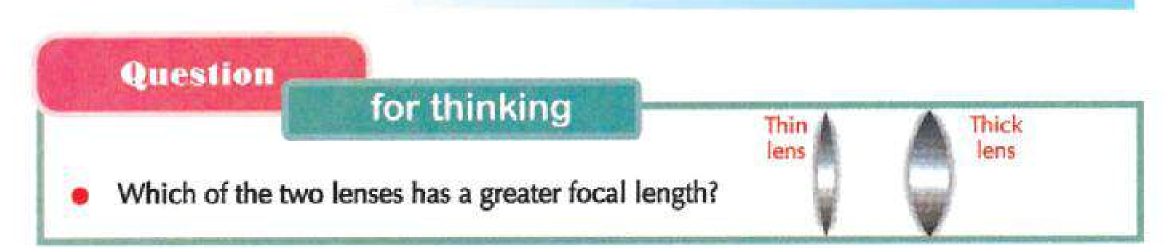
▲ Figure (16): The convex lens forms a real image of the sun on a piece of paper



▲ Figure (17): Parallel rays are collected at the focus on the far side of a conve lens

What do you deduce?

- Light rays passing through the convex lens converge to a point called "the focus of the lens".
- The lens in this case is known as converging because the rays passing through it converges at a point.



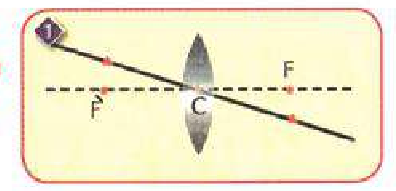
- Which of the two lenses has a greater focal length?

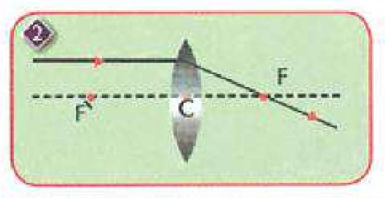
The image formed by the convex lens:

To study the cases of the formation of the image by using the convex lens we will use three rules to determine the direction of the light ray after passing through the lens.

1. The incident light ray passing through the optical centre of the lens passes through the lens without refraction.
2. The incident light ray parallel to the principal axis, exits from the lens passing through the focus
3. The incident light ray passing through the focus, exits from the lens parallel to the principal axis.

When an object is placed in front of the convex lens the position of the images formed and their properties can be determined by using only two rays from the previous three rays.





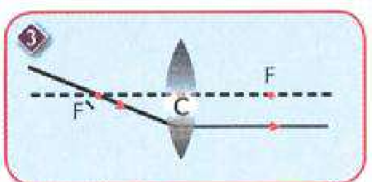


Figure (18): Three rules for light rays passing through the convex lenses.

The cases of the formation of the images by the convex lens (converging):

To determine the position and characteristics of the formed image by the convex lens, follow the following steps:

1. Use the compass to draw the convex lens
2. Draw the principal axis of the lens (it is a straight line passing by the focus and the optical centre of the lens).
3. Determine on it the position of the focus (f) and twice the focal length (c) on the principal axis from both sides of the lens.

4 Draw a ray coming from the highest point of the object so it falls parallel to the principal axis thus it refracts and exits from the lens passing through the focus.

5 Draw a ray from the same point passing by the optical centre of the lens, thus exits with no refraction.

6 The position when the two penetrating rays intersect determines the image of the lit point.

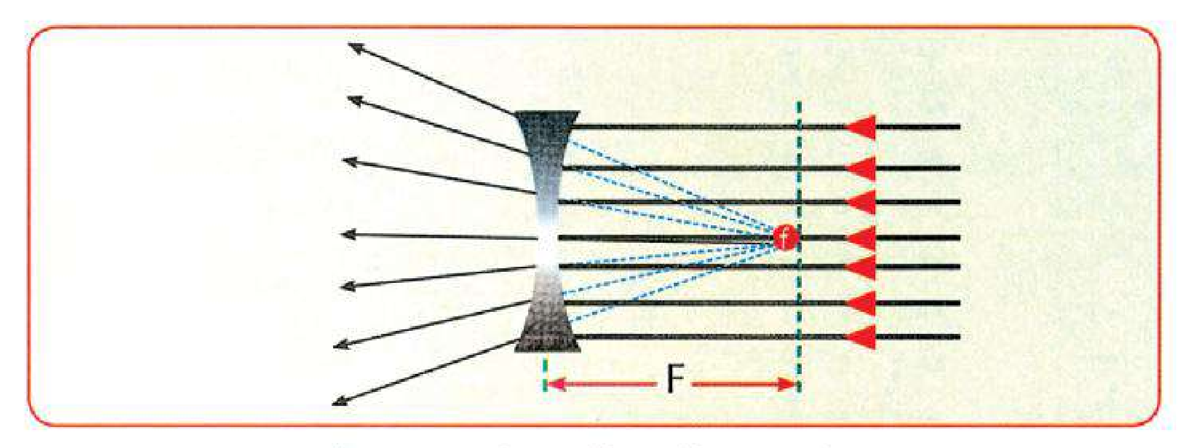
7 Determine the position and properties of the images formed in the five cases shown in the following table and compare the results you obtain to those present in the table.

Position of the body	Position of the image	properties of the image	Cases of image formation
Greater than twice of the focal length	Between the focus and twice the focal length	Real, inverted, and diminished	The object, C, F, F, C, The image
At twice the focal length	At twice of the focal length	Real, inverted and equal to the object	The object, C, F, C, The image
Between the focus and twice of the focal length	At a distance greater than twice of the focal length	Real, inverted and magnified	The object, C, F, F, C, The image
At the focus	At the infinity	The rays exit parallel	The object, F, F
At a distance smaller than the focal length	At the side of the object	Virtual, upright and enlarged	The image, F, F

Second: The concave lens

The focus of the concave lens:

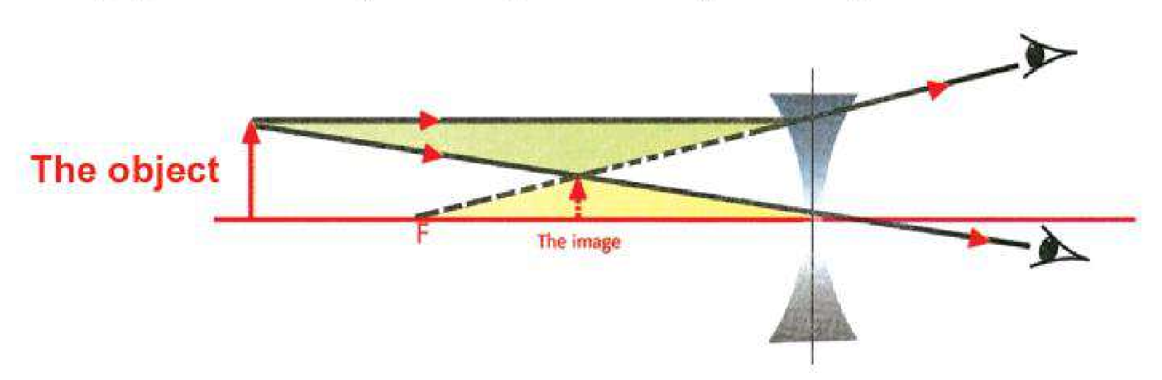
If parallel rays fall on the concave lens, the rays pass through the concave lens and get awayfrom each other (diverging) as if they come from a point in front of the lens called "The **principle** focus of the concave lens" and it is a virtual point (cannot be received on a screen). The lens is also known in this case as the diverging lens because it diverges the rays after they pass through it.



▲ Figure (19): The virtual focus of the concave lens

The image formed by the concave lens:

The image formed by the concave lens is always virtual, smaller and erect. In figure (20) we used two rays to identify how the image of the object is formed.



▲ Figure (20): The image formed by the concave lens is always virtual, erect and diminished

The use of lenses to treat the vision defects

The most important of the vision defects: short-sightedness – long-sightedness.

These defects occur because the lens of the eye is not always convex, or the eye is not always spherical. The person with normal vision sees the far object clearly (the far object according the normal eye is present at 6 m). This clear vision remains if the object comes closer at a distance not less than 25 cm.

1 Short-sighted:

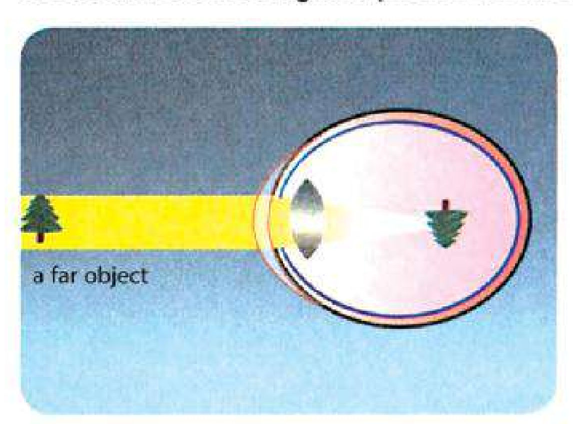
- A person is said to be short-sighted when the eyes only sees the near objects clearly, but the far objects seem distorted and that is because the images of these objects do not fall on the retina of the eye but in front of it.

What causes short-sightedness?

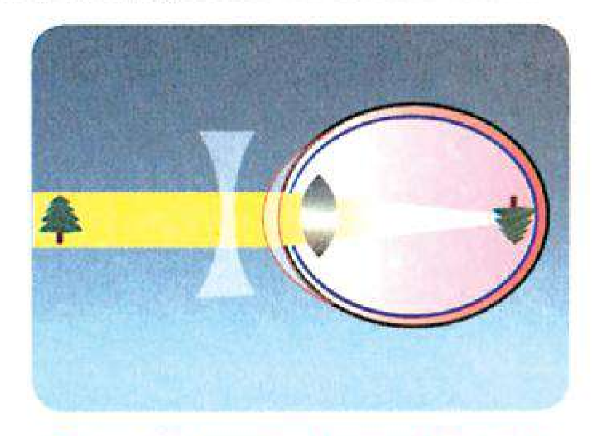
1. Due to elongation in the ball which causes the retina to be far from the eye lens.
2. The surface of the eye lens is more convex which results in a smaller focal length of the eye lens, then the parallel rays coming from the far object is collected at a point in front of the retina and disperses after that forming an unclear image on the retina (Figure 21).

Correcting short-sightedness

By using a concave lens which diverges the rays to form the image of the objects on the retina. A short-sighted person needs a medical eye glasses with concave lenses.



▲ Figure (21) Formation of image in front of retina



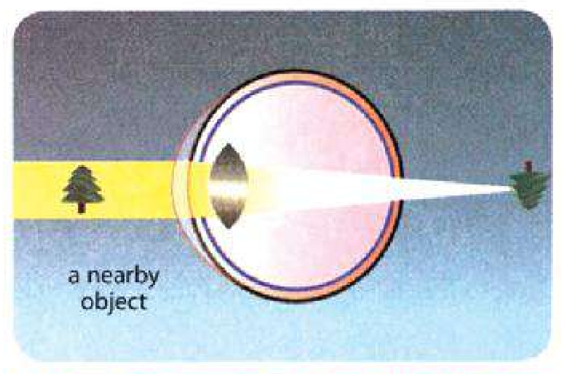
▲ Figure (22) Formation of image on the retina by using a concave lens

2 Long-sighted:

A person is said to be long-sighted when he only sees the far objects clearly but the close objects are not seen clearly and that is because the image of the close objects do not fall on the eye retina but behind it.

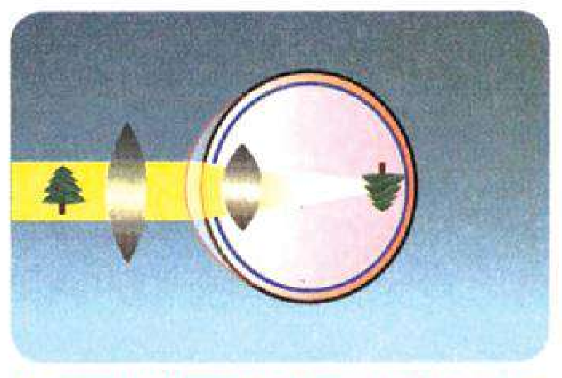
What causes long-sightedness?

1. As a result in the shortness of the radius of the ball thus the retina is close to the eye lens.
2. The eye lens surface is less convex which causes the increase in the focal length so the rays exiting from the near object are collected at a point behind the eye retina.





▲ Figure (23): Formation of image behind the retina



▲ Figure (24): Formation of image on the retina by using a convex lens

Correcting long-sightedness

Long-sightedness is treated by using convex lens which collects the rays so the images of the objects are formed on the retina; therefore, the long-sighted person needs a medical eye glasses with convex lenses.

Contact lenses:

The contact lenses are used instead of the glasses. It is very thin lenses made of plastic, and can stick to the eye cornea by the eye fluid.



▲ Figure (25): contact lenses

For extra activities and practice, go to MOE website.







Science, Technology, and Society

Enriching activity:

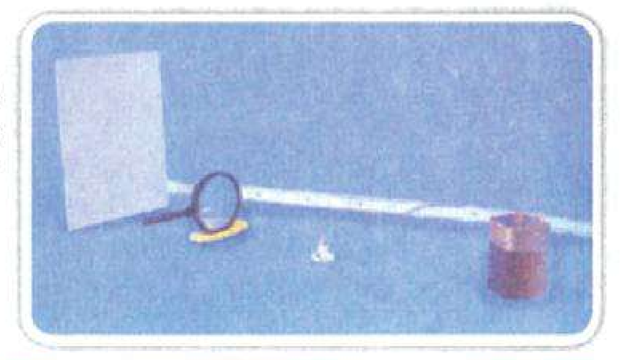
Land areas measurement:

Land surveyors and topographical scientists use a special device to determine heights and distances by sending a beam of laser rays, the receiving it again by the mirrors and lenses provided in their devices.
so, it is possible to make very accurate measurements to calculate the time that a laser beam bounced from a distant point and returns to its source.



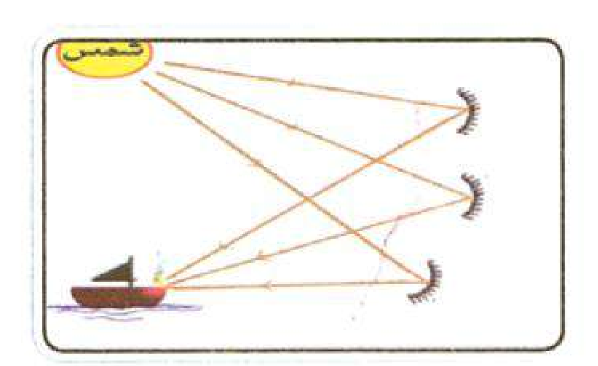
Make a model

Draw a schematic diagrams showing how the proprerties of the image formed by a convex lense changed by changing the focal length.



History

According to the old Greek legend that Archimedes knew a lot about mirrors and the use of sunlight as a weapon against the Roman fleet that invaded sicily in 212 B.C.

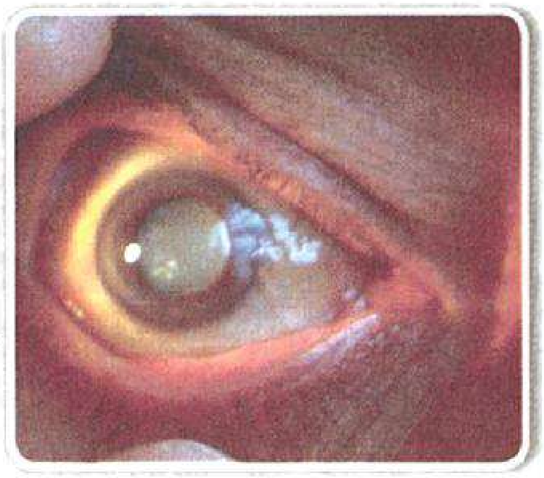


A huge concave mirror was placed to collect the sun rays and directed them towards the sails of ships so as to generate extreme heat that led to the burning of these sails and turning them to glazing fire balls.

Science integration (Medicine)

Cataract

The eye gets suffer from some diseases. due to some reasons.



Cataract is one of the most dangerous diseases that infect the eye as a result of old age, illness, side effects of drugs in addition to genetic readiness. When the eye gets injured by cataract the eye lens becomes opaque. Treatment is done through surgery to exchange the eye lens with a plastic lens transplanted permenantly in the eye. In this way, the person can see again and clearly .

The first term - Unit Three

The Universe and the Solar System

Introduction

The vast universe is filled with millions of stars that are not enough to light this extensive universe. This is because there are billion kilometers of cold dark space among these stars.

Everything changes in the universe. On Earth, generations of humans and living organisms change. The same goes for stars as they always change so that the universe is never constant.

All galaxies get away from each other very fast. The universe is continuously in a state of expansion.



UNIT OBJECTIVES

By the end of this unit, you should be able to:

- ✔ Identify some theories of cosmogony.
- ✔ Identify some theories of the evolution of the solar system.
- ✔ Identify the rotation of the solar system around the centre of the galaxy.
- ✔ Explain the difference in the length of day and year from a planet to another.

Included issues

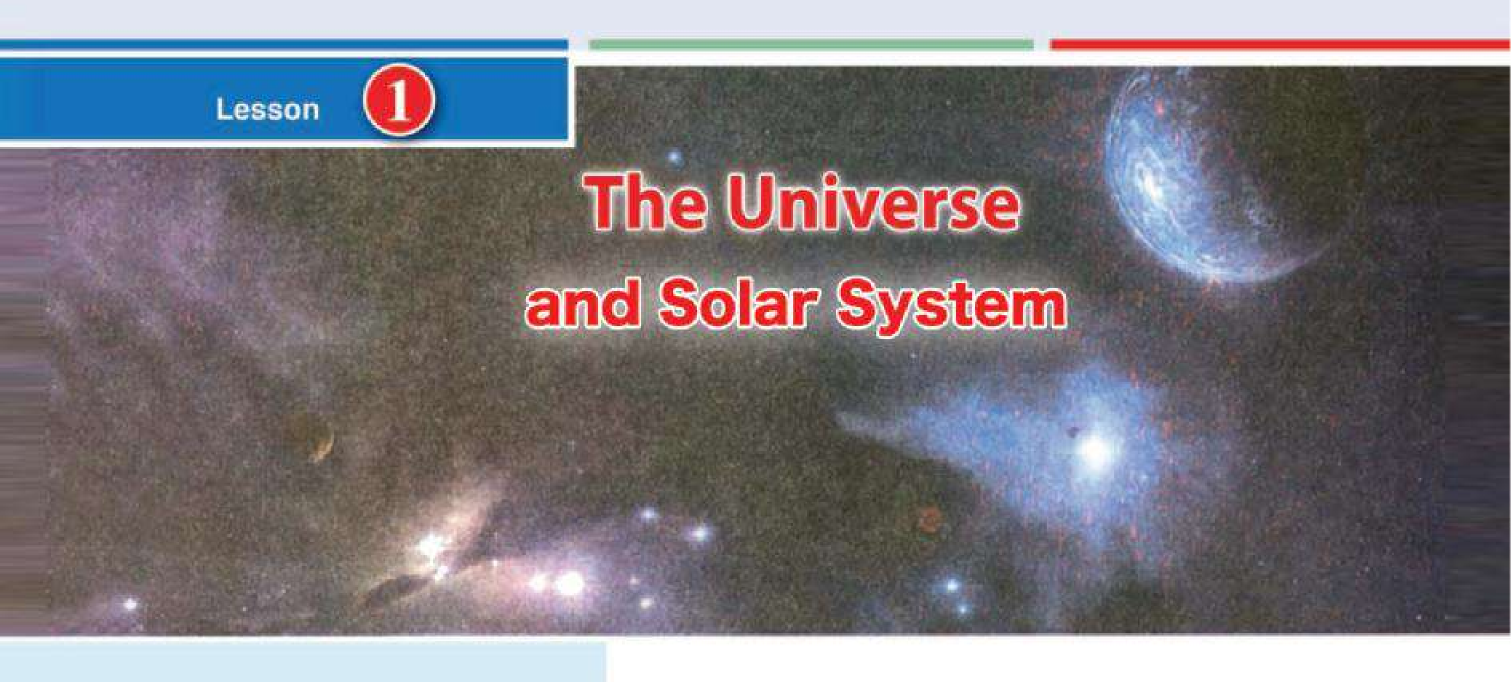
- The greeatness of Allah
- Unity of the universe



Lesson 1

The universe and solar system

Lesson 1



The Universe and Solar System



Lesson objectives

By the end of this lesson, you should be able to:

- Identify the components of the universe.
- Identify the galaxies.
- Determine the location of the solar system in the Milky Way.
- Identify the latest theories of cosmogony.
- Realize the greatness of Allah.



Lesson terms

- The universe
- The galaxy
- The stars

What is the universe?

The universe is the space which contains all the galaxies, stars, planets, moons, living organisms and everything. The universe is vast beyond comprehension. The sun and the earth are a tiny part in the universe.

In the universe, groups of stars are gathered to form galaxies. The universe contains many galaxies and each galaxy has a distinctive shape according to the harmony and order of the groups of stars in it. The sun is one of the stars of our galaxy (Milky Way).

The Milky Way Galaxy

In the centre of the galaxy a lot of old stars gather surrounded by small stars located in the spiral arms of the galaxy. Our sun is a star of millions of stars in this galaxy.



Figure (1) The Milky Way Galaxy

The universe :

- It is a wide and extended space that contains galaxies. The number of galaxies in the universe is about 100,000 million galaxies.

Galaxies:

- Galaxies gather in clusters including the Milky Way which contains millions of stars including the sun.

The Milky Way:

- It contains the sun and the solar system.

The solar system:

- It is the sun and eight planets revolving around it

The earth:

- The planet of life



Humans

Information

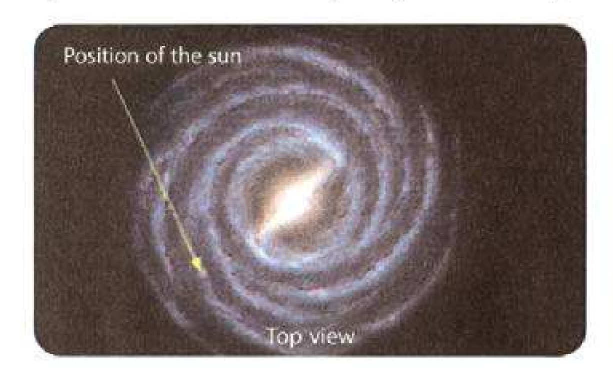
Enriching information:

- The Milky Way is given that name because it appears in the sky at night as a splashing milk or spreading straw.



The solar system

Planets revolve around the sun and the surrounding planets revolve around the centre of the galaxy (Milky Way). The sun takes about 220 million years to complete one rotation around the centre of the galaxy. The solar system is located in one of the spiral arms of the Milky Way on the edge of the galaxy.



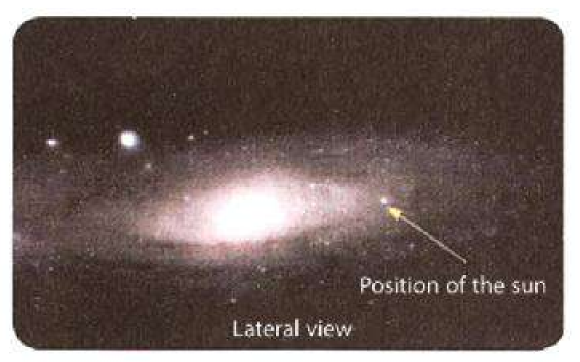


Figure (2) The position of the sun in the Milky Way

How did the universe originated?

Many scientists believe that the universe emerged from a massive explosion called the Big Bang 15000 million years ago which resulted in all forms of matter, energy, space and time. There was no one to relate what happened. But the outstanding discoveries in physics and astronomy enabled scientists to trace the history of the universe from the first second fraction of its evolution. They believe that before explosion the universe matter was a gaseous ball of high pressure and high temperature in a small volume. It is in a constant expansion. The Big Bang theory had been developed since 1933.

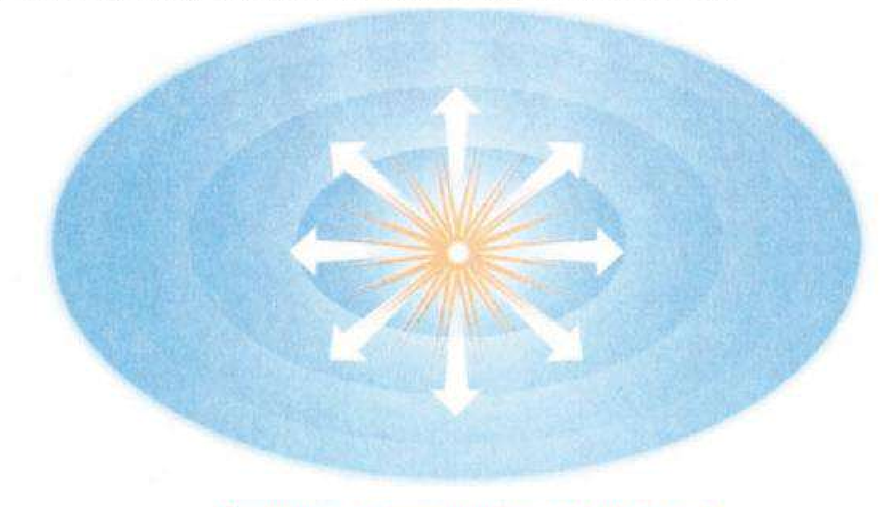
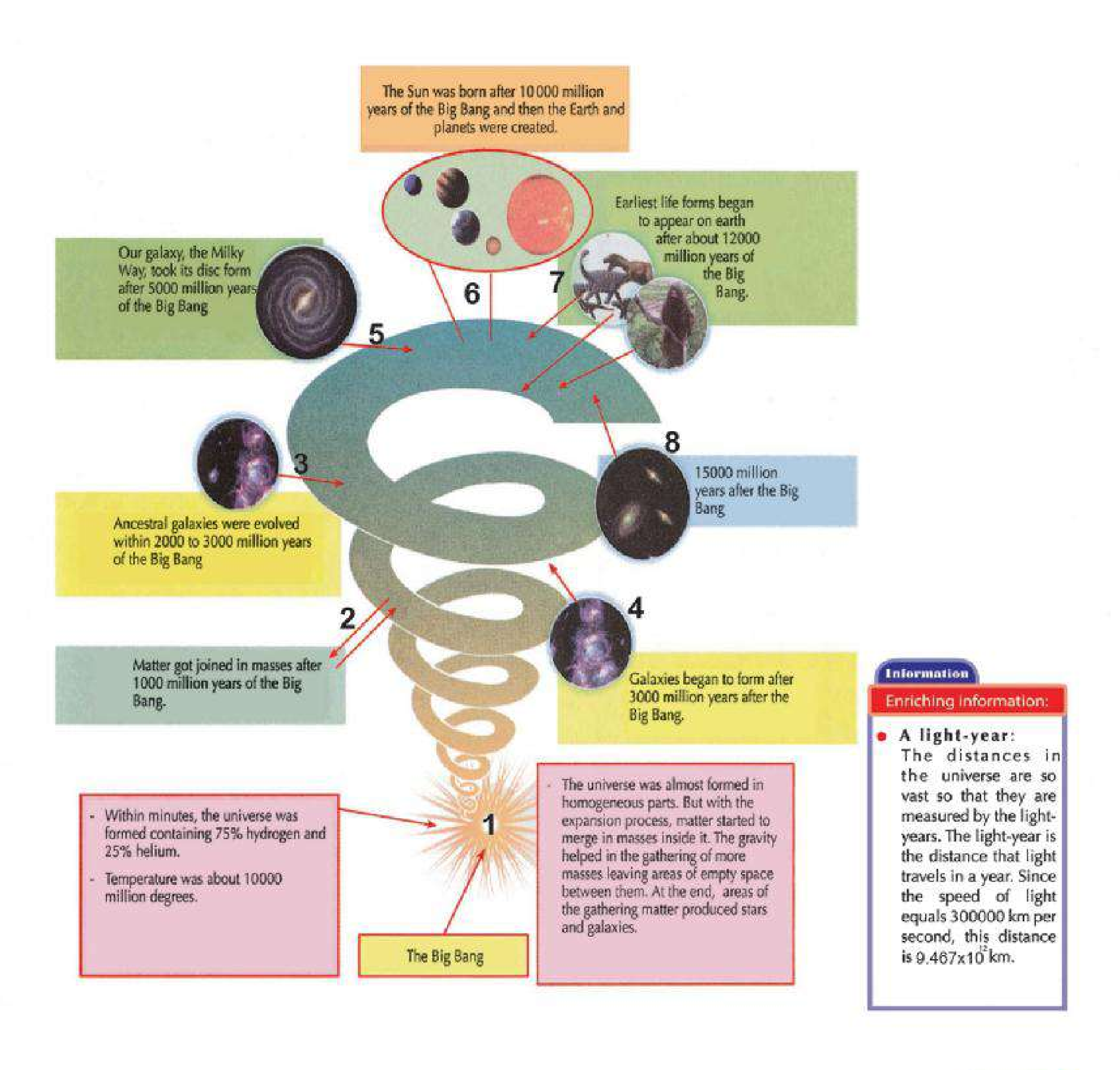


Figure (3) An imaginary shape of the big bang

The Big Bang

Since about 15000 million years, the universe was very small and very hot. Through the Big Bang, the process of expansion and changing started and it continues to this day. Within minutes of the explosion, the atomic particles merged together producing helium and hydrogen which over the years produced galaxies, stars and the universe as we know it today.



Information

Enriching Information:

- **A light-year:** The distances in the universe are so vast so that they are measured by the light-years. The light-year is the distance that light travels in a year. Since the speed of light equals 300000 km per second, this distance is 9.467×10^{12} km.



Expansion of the universe and distances of galaxies

Tools:

Some water - some flour - some raisin - glass container - some of the bread yeast.

Steps: cooperate with a group of your colleagues to perform this activity

1. Bring some flour and mix it with some water and some of the bread yeast.
2. Mix the ingredients well to make bread dough.
3. Insert some raisins in the dough.
4. Leave the dough to ferment in a warm environment.





▲ Figure (5) distance of galaxies in the universe looks like distance of the raisins in the dough during its fermentation

What do you abserve?

....

What does the continuous swelling of the dough look like?

....

What does the distance of the raisins represent?

....

What do you conclude of the distances between the raisins?

....

The universe is in continuous expansion due to the movement of galaxies apart.

Information

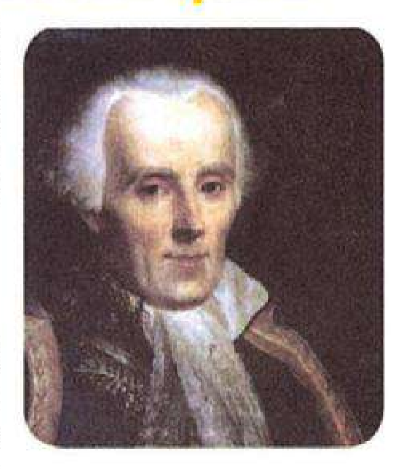
Enriching information:

- In 1964, scientists coincidently discovered radio waves coming from space. They concluded that these waves are a type of the echo coming from the Big Bang. T.V sets can receive such signals on the Earth. For more information, log on the internet.



Theories about the evolution of the solar system

There are many scientific and philosophical theories about the evolution of the solar system. They are about twenty theories and they (as we shall see) are still unproved and subject to change. We will review the most important of these theories to recognize the evolution of scientific ideas about the evolution of the solar system.



▲ Figure (8): The French scientist Pierre Simon Laplace

1 Nebular assumption (Laplace 1796)

The French scientist Pierre Simon Laplace published a research entitled " world order " and that was in 1796. This research included a vision of Laplace about the evolution of the solar system. This perception (which won great reputation for a century) has been affected by two observations, which are:

- There is something that looks like clouds or nebula in the space.
- The space contains many cloudy rings surrounding some planets such as the rings of Saturn.

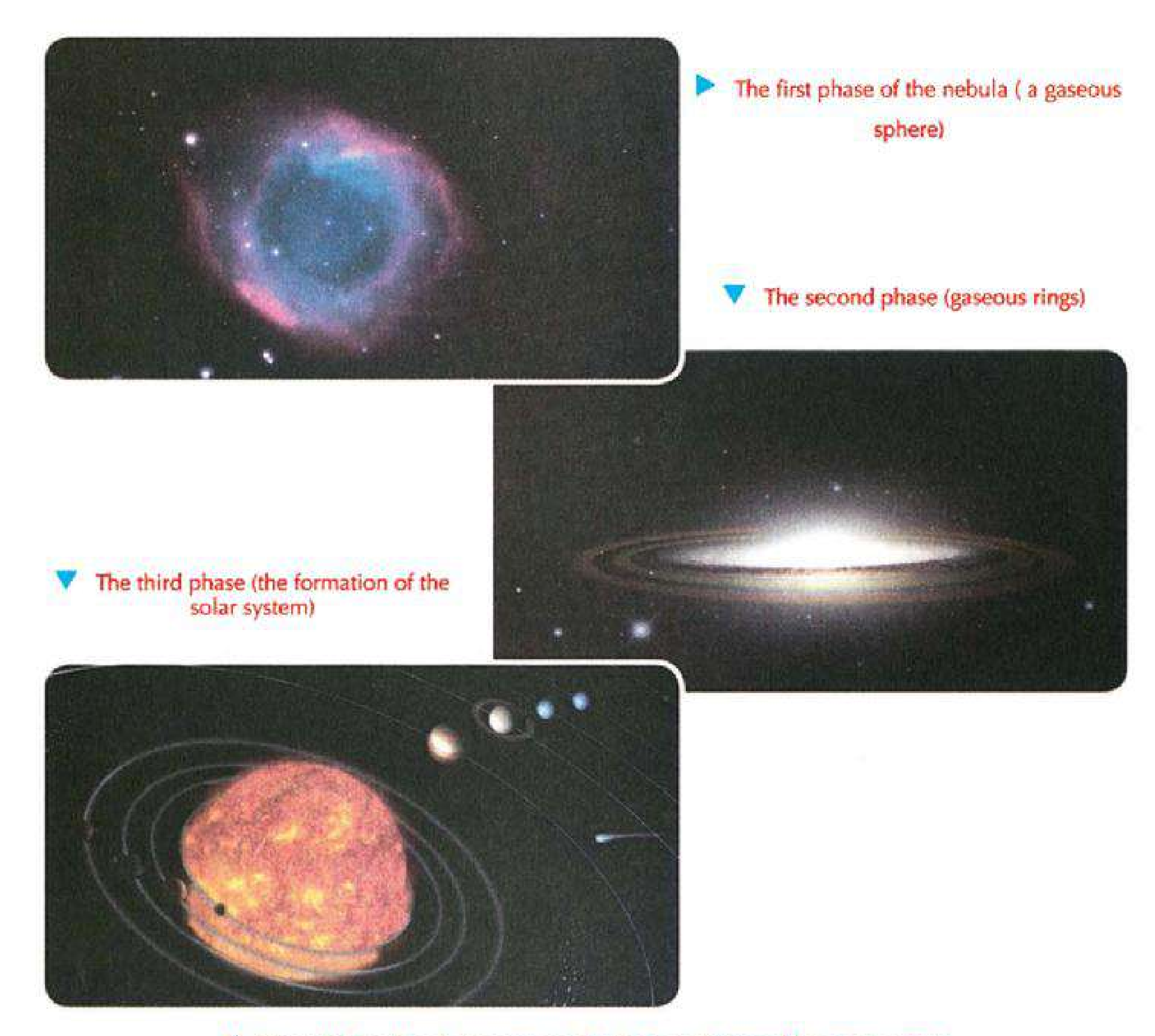
Information

Enriching information:

- Gravity keeps planets in their orbits around the sun and moons in their orbits around planets. The effect of gravity decreases with increasing distance, when the planet moves away from the sun the gravity decreases and its movement becomes slower.

This theory suggested that the solar system developed as the following:

- The solar system was a glowing gaseous sphere revolving around itself. This sphere is called nebula. Over the time, the nebula gradually lost its heat so its size contracted and its revolving speed around itself increased.
- Under the effect of centrifugal force, the nebula lost its sphere form and became in a form of a flat rotating disk. Parts got separated from it by the effect of the centrifugal force to form gaseous rings that also rotate in the same direction in which the nebula rotates.
- These gaseous rings were formed after the planets of the solar system got cooled and frozen. The flaming mass that remained in the centre formed the sun.



The first phase of the nebula (a gaseous sphere)

The second phase (gaseous rings)

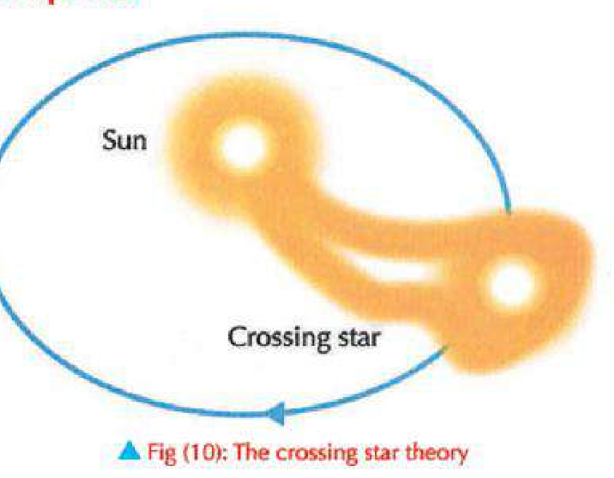
The third phase (the formation of the solar system)

Figure (9): Laplace's conception about the evolution of the solar system

❷ The crossing star theory (Chamberlain and Molten 1905)

The crossing star theory is based on some assumptions:

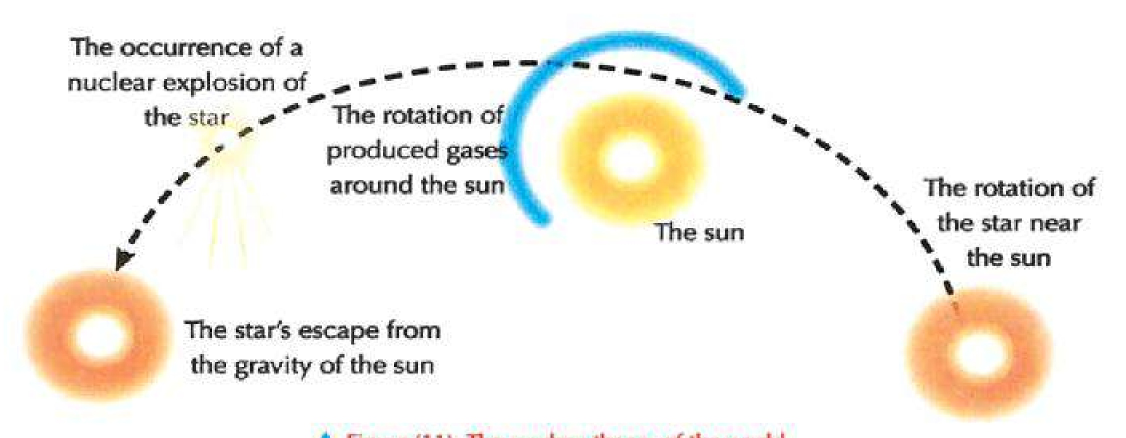
- The solar system was originally a big star which is the sun.
- Another huge star approached the sun.
- This star attracted the sun to it; an act which led to a great expansion in the part of the sun facing it.
- This expanded part was exploded and a gaseous line was formed of a great length from the sun to the last planet.
- The gaseous line started to condense due to the attraction forces and then it cooled forming the planets.
- The sun escaped from the gravity of that star due to the explosion.



▲ Fig (10): The crossing star theory

❸ The modern theory of the world (Fred Hoyle, 1944)

This theory is based on what is sometimes seen when a star glows for a short time to be one of the most shining stars in the sky. After a day or two, its glow disappears gradually to return as it was. The reason for that glowing is not precisely known. It may be due to the explosion of the star as a result of nuclear reactions that occur so suddenly and violently that the star bombs huge amounts of gaseous materials. Then, its size increases and accordingly its shining increases as well. When the bombed gases are cooled, its shining returns as it was.



▲ Figure (11): The modern theory of the world

Fred Hoyle used this fact to develop his conception and assumptions about evolution of the solar system. He assumed:

- The existence of a star rotating near the sun.
- The Star was exposed to explosion due to huge nuclear reactions.
- The force of the explosion led to the bombing of the stat's nucleus away from the gravity of the sun.
- A cloud of gas remained and was subject to cooling and contraction processes forming planets.
- the force of the sun's attraction controlled the orbits of planets around it.
- Planets which the force of the sun controlled the determination of their orbits were evolved.

For extra activities and practice, go to MOE website.





Science, Technology and Society

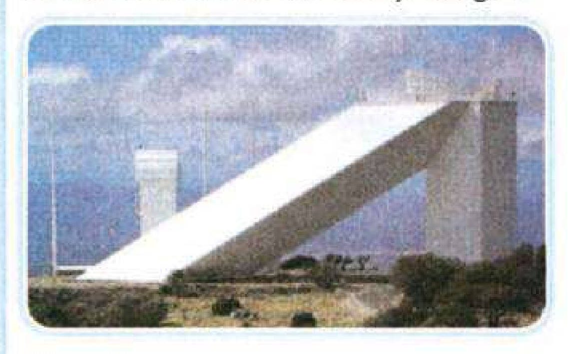
A technological application

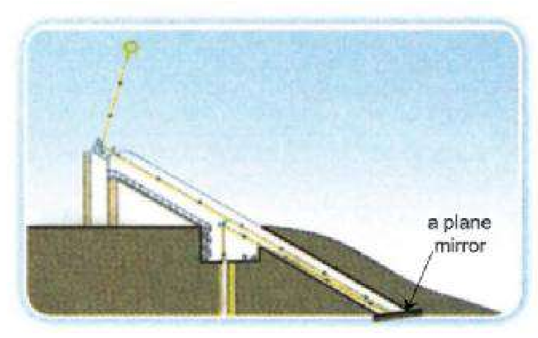
The solar telescope

Astronomers use special equipment centered on Earth or carried into space in order to study the sun. The sunlight is gathered then separated by the spectrometer into a solar spectrum (shows the different light wavey lengths emitted by the sun).

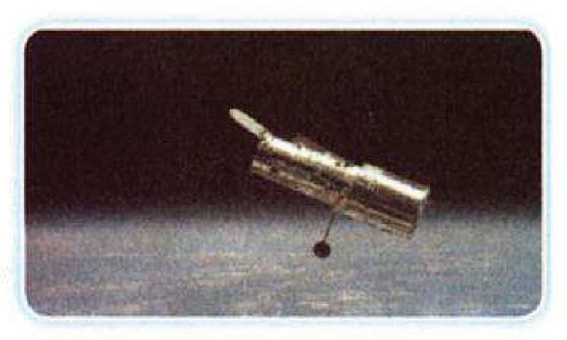
It is worth mentioning that astronomers got most of their information about the sun from the study of its spectrums.

This type of telescope works on reflecting the sun rays downward to a mirror in a tunnel under the Earth's surface. A picture of the sun is formed in a monitoring room where astronomers can study its light.





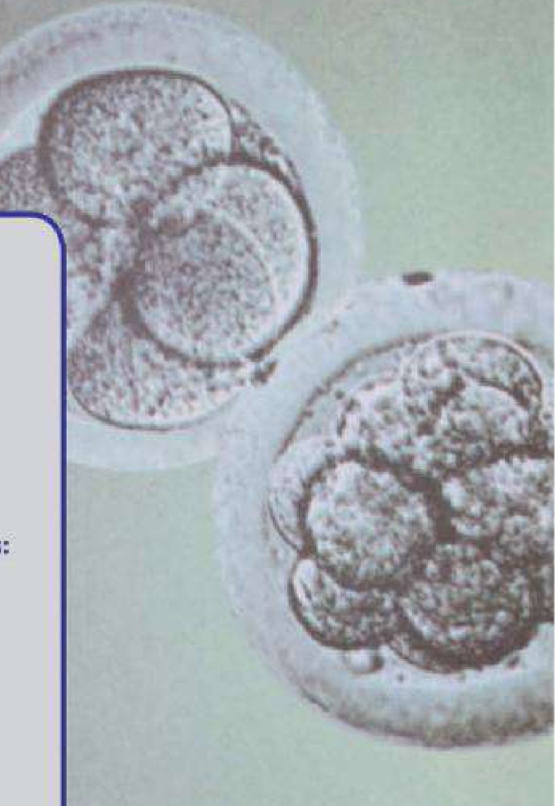
The Hubble telescope



The Hubble telespe was Iaunched in April in 1990 in an orbit around the earth at a height of 500 Km. from its location it was collecting photos for locations and events took place millions of years ago These photos allow astronomers an opportunit to study the evolution of the universe after the Big Bang.

The first term - Unit Four

Reproduction and Species Continuity



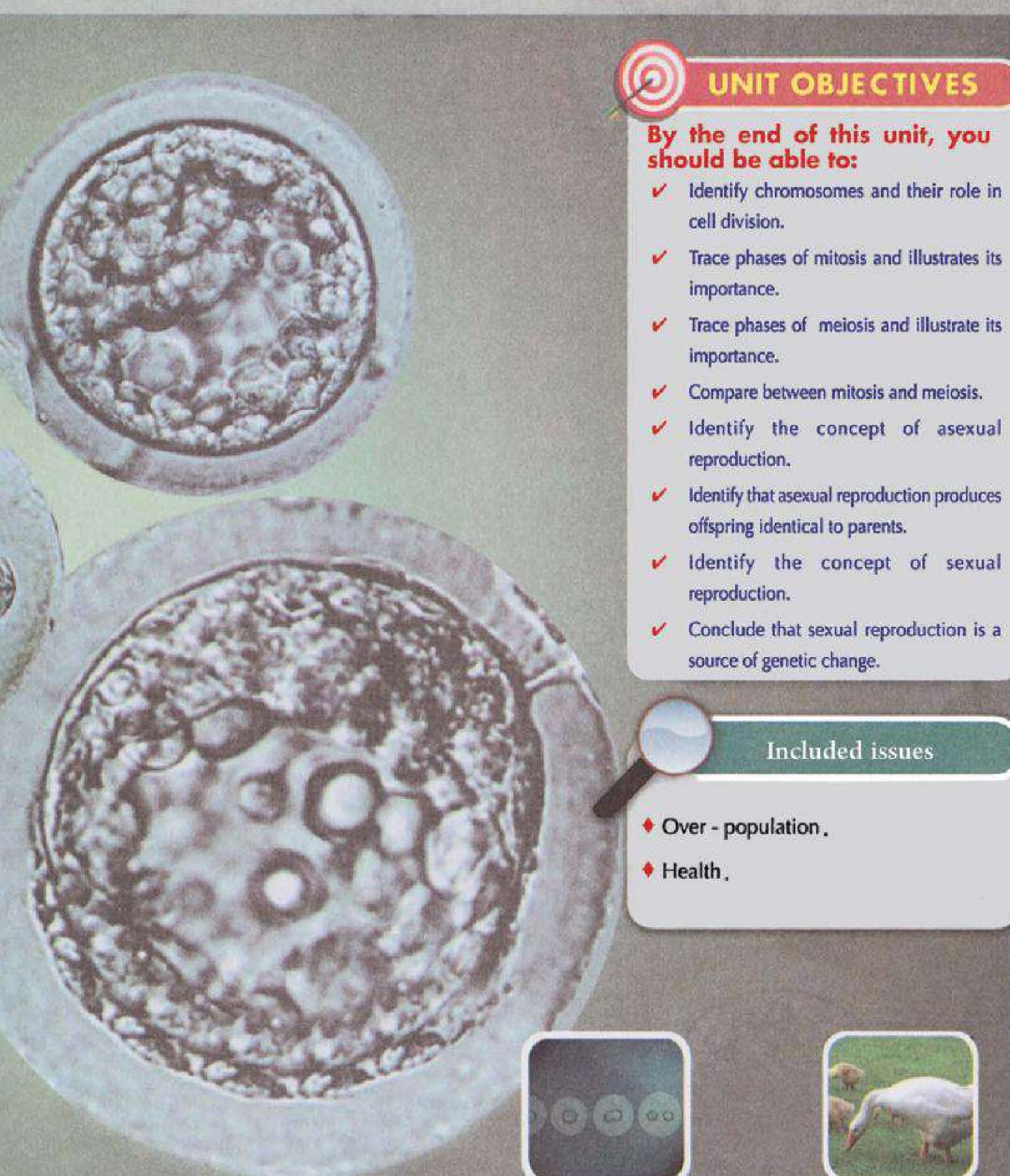
Introduction

The reason behind creation is the continuity of species. This is to keep the living organisms from extinction and ensure their interaction with environment.

This occurs through reproduction that basically takes place through the continual divisions of cells. Cellular divison differs among different living organisms. It includes two types of divisions:

- ✓ Mitosis that aims to increase the number of cells.
- ✓ Meiosis that aims to decrease the number of chromosomes to half during the formation of gametes.

Reproduction is classified according to the species of living organisms: simple living organisms are divided asexually to produce offspring identical to parents, whereas other complex living organisms reproduce sexually sexual reproducation are a source of genetic variation.



UNIT OBJECTIVES

By the end of this unit, you should be able to:

- ✔ Identify chromosomes and their role in cell division.
- ✔ Trace phases of mitosis and illustrates its importance.
- ✔ Trace phases of meiosis and illustrate its importance.
- ✔ Compare between mitosis and meiosis.
- ✔ Identify the concept of asexual reproduction.
- ✔ Identify that asexual reproduction produces offspring identical to parents.
- ✔ Identify the concept of sexual reproduction.
- ✔ Conclude that sexual reproduction is a source of genetic change.

Included issues

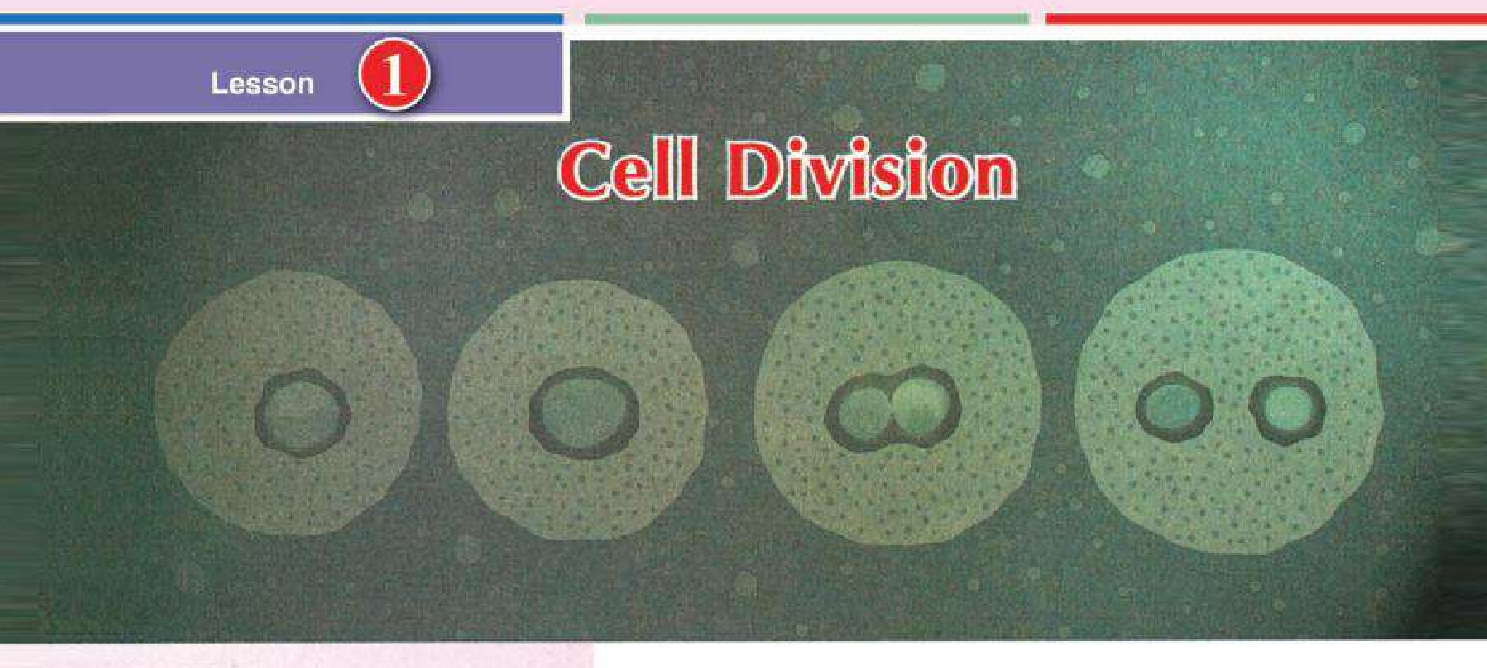
- ♦ Over - population.
- ♦ Health.

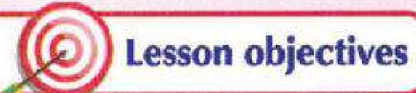
Lesson 1
Cell division

Lesson 2
Asexual and sexual reproduction

Lesson 1

Cell Division





Lesson objectives

By the end of this lesson, students should be able to:

- ✔ Identify chromosomes and their role in cell division.
- ✔ Trace phases of mitosis division and illustrate its importance.
- ✔ Trace phases of meiosis and illustrate its importance.
- ✔ Compare between mitosis and meiosis.
- ✔ **Appreciate the importance of meiosis in reproduction of arganisms.**



Lesson terms

- Chromosomes.
- Mitosis.
- Meiosis.

What is the importance of cell division process to living organisms?

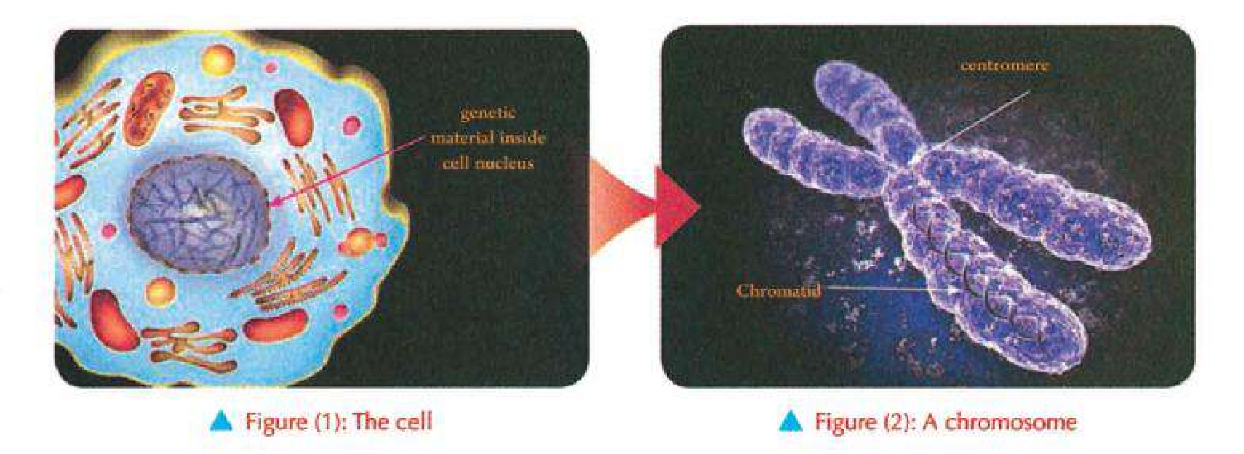
Multicellular organism's bodies contain two types of cells: somatic cells and reproductive cells. Each type is divided in a special way.

- Somatic cells are divided by mitosis which leads to the growth of living organisms and compensation of the damaged cells.
- Reproductive cells are divided by meiosis which leads to the formation of gametes (male and female gametes) which are responsible for reproduction in living organisms and the transfer of genetic traits from parents to their offspring.



Which part of the cell is responsible for cellular division?

The cell nucleus contains the genetic material of the living organism. This genetic material consists of a number of chromosomes, which have the main role in cell division.



▲ Figure (1): The cell

▲ Figure (2): A chromosome

General structure of the chromosome :

Notice the figure above to see that the chromosome consists of two connected threads at the centromere. Each thread is called chromatid. The chromosome chemically consists of nuclear acid called DNA and protein. The DNA carries the genetic information of the organism.

Information

Enriching information:

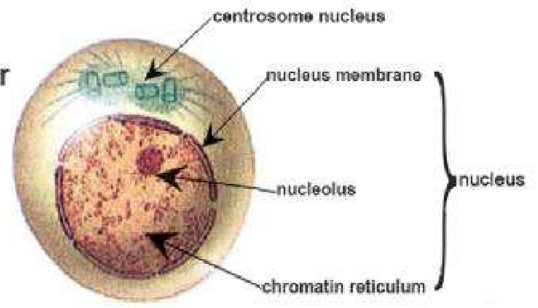
- The number of chromosomes in living organisms is different from one species to another but fixed in members of the same species. Somatic cells in most living organisms contain two sets of chromosomes (one inherited from the father and the other inherited from the mother) known as the diploid number (2N), while the gametes (male gametes (sperms) female gametes (ova) contain the haploid number (N). Knowing the number of chromosomes helps in determining the animal and plant species.

First: Meiotic division

Did you ever wonder: How does your body grow? How does the seed grow? How do the roots, stems and leaves grow?

Mitosis occurs in the somatic cells of organisms. It leads to the growth of the living organisms and compensation of their damaged cells.

Before studying the phases of this division, you must understand that before starting division the cell passes through a phase where some important biological processes occur to prepare the cell for division. This phase is called **interphase** in which the amount of DNA (the genetic material) duplicates.



▲ Figure (3): Interphase

Then the cell enters into the mitosis which takes place through the following four phases:

1 Prophase

Observe their figure that shows the:

- Chromatin reticulum condenses and appears in the form of long, thin and double strings (chromosomes).
- A network of filamentous fibres called a spindle is composed and extend between the two poles of the cell.
- The spindle fibres in the animal cell is formed from the centrosome.
- In the plant cell, the spindle is composed from the cytoplasm at the cell poles.
- Each chromosome is connected with one of the spindle fibres by the centromere.
- At the end of this phase, the nucleolus and nuclear membrane disappear.





▲ Figure (4): Prophase

2 Metaphase :

- In this phase, chromosomes are arranged along the cell equator where each chromosome is attached with one of the spindle fibers at its centromere.

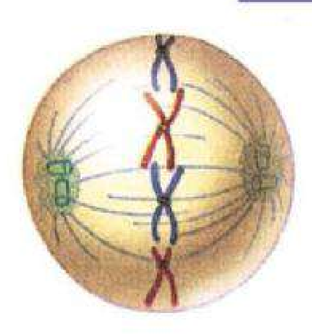
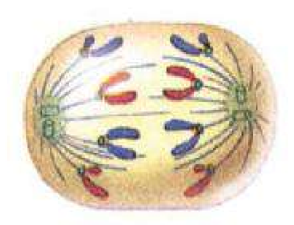


Figure (5): Metaphase

3 Anaphase:

- the Centromere of each chromosome splits lengthwise into two halves. Chromatids in each chromosome become a part from each other and separate
- Spindle fibers begin to shrink , so two identical groups of chromatids are formed. Each group migrates towards one of the cell's poles.



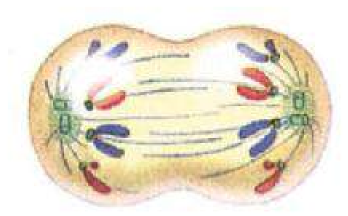


Figure (6): Anaphase

4 Telophase:

- In this phase, a series of adverse changes occur which lead to the formation of a complete set of chromosomes that have the same number of the mother cell's chromosomes. Nuclear threads, a nuclear network and then two new spearate cells are formed. Each cell has the same number of chromosomes of the mother cell (2n).





Figure (7): Telophase

Second: Meiotic division

How the sperms and ova in humans and animals are formed? And how pollen grains and ovules in flowering plants are created?

Meiosis occurs in living organisms that reproduce by gametes. In humans and animals, this division occurs in the testis to produce the male gametes (sperms) and in the ovary to form the female gametes (ova). Similarly, in flowering plants this division occurs in the **anther** to produce the pollen grains and in the flower's ovary to form an ovum.



Fig (8): Interphase I

Meiosis is different from **mitosis** in that each produced cell contains half the number of chromosomes of the parent cell. This reduction occurs by the meiosis in two successive stages where the chromosomes are doubled once in the interphase that takes place before the beginning of the first meiotic division.

First meiotic division

1 Prophase I:

- Chromatin reticulum intensifies and appears in form of distinct chromosomes, then chromosomes are arranged in homologous pairs, each pair consists of 4 chromatids and called a tetrad.
- At the end of the prophase 1, nuclear membrane disappears and every two homologous chromosomes (in the tetrad) start to move away from each other. Each chromosome consists of two chromatids linked together by the centromere. The spindle appears and the chromesomes get connected with spindle fiber.



Fig (9): Prophase I

2 Metaphase I:

- In this phase, chromosomes pairs arrange on the cell's equator.

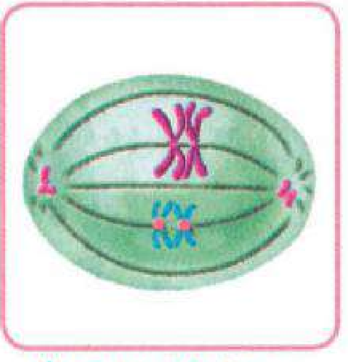
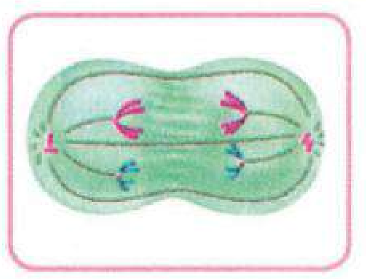


Fig (10): Metaphase I

3 Anaphase I :

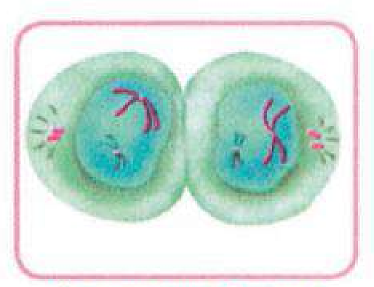
- In this phase every two homologous chromosomes move away from each other as the spindle fibers shrink. One of the two chromosomes migrates towards a cell pole and the other migrates towards the other pole. Each pole contains half the number of chromosomes of the parent cell.



▲ Figure (11): Anaphase I

4 Telophase I:

- In this phase, at each of cell's poles a nuclear membrane is formed around the chromosomes. So, there are two nuclei. Each one has half the original number of chromosomes of the parent cell. Then the cell enters into the second meiotic division.



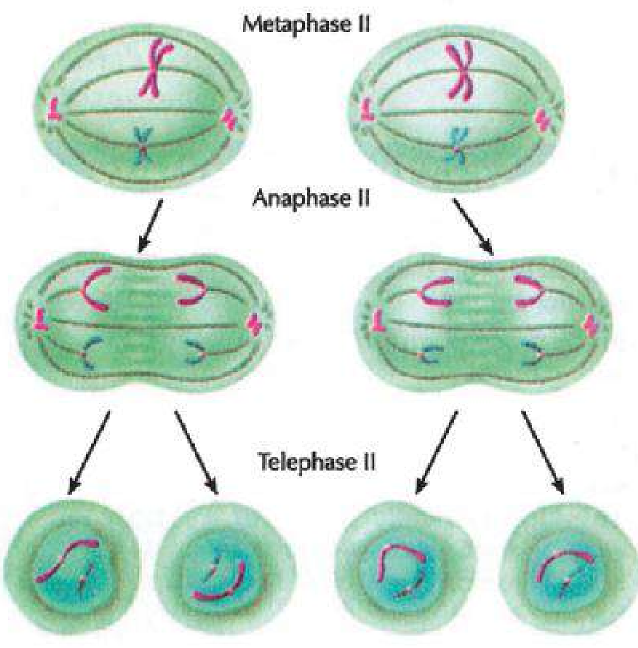
▲ Figure (12): Telophase I

Second meiotic division:

It aims to increase the number of produced cells. Each cell is called the (gamete), containing half the number of species chromosomes.

Each cell of the two cells which resulted from the first meiotic division is divided in a way similar to **mitosis division** phases. In the final phase (telophase II) of this division, four cells are produced and each of them contains half the number of chromosomes of the parent cell.

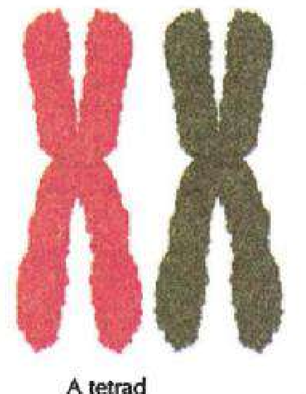
When male gamete combines with female gamete, the zygote is formed. It contains the original number of the organism's chromosomes. Thus, the number of chromosomes remains constant in the cells of individuals of the same species.



▲ Figure (13): Second meiotic division

The crossing over phenomenon

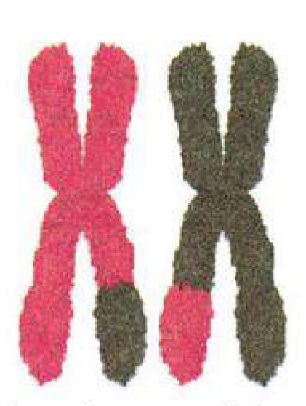
- At the end of prophase I, some pieces of the two inner chromatids of each tetrad are exchanged to produce new genetic arrangements. This process is called the crossing over phenoemon.



A tetrad



The inner chromtids of homologous chromosames come close to each other



Exchange of some parts of the two inner chromitds in a tetrad

▲ Figure (14): The crossing over phenomenon

What is the importance of the crossing over phenomenon?

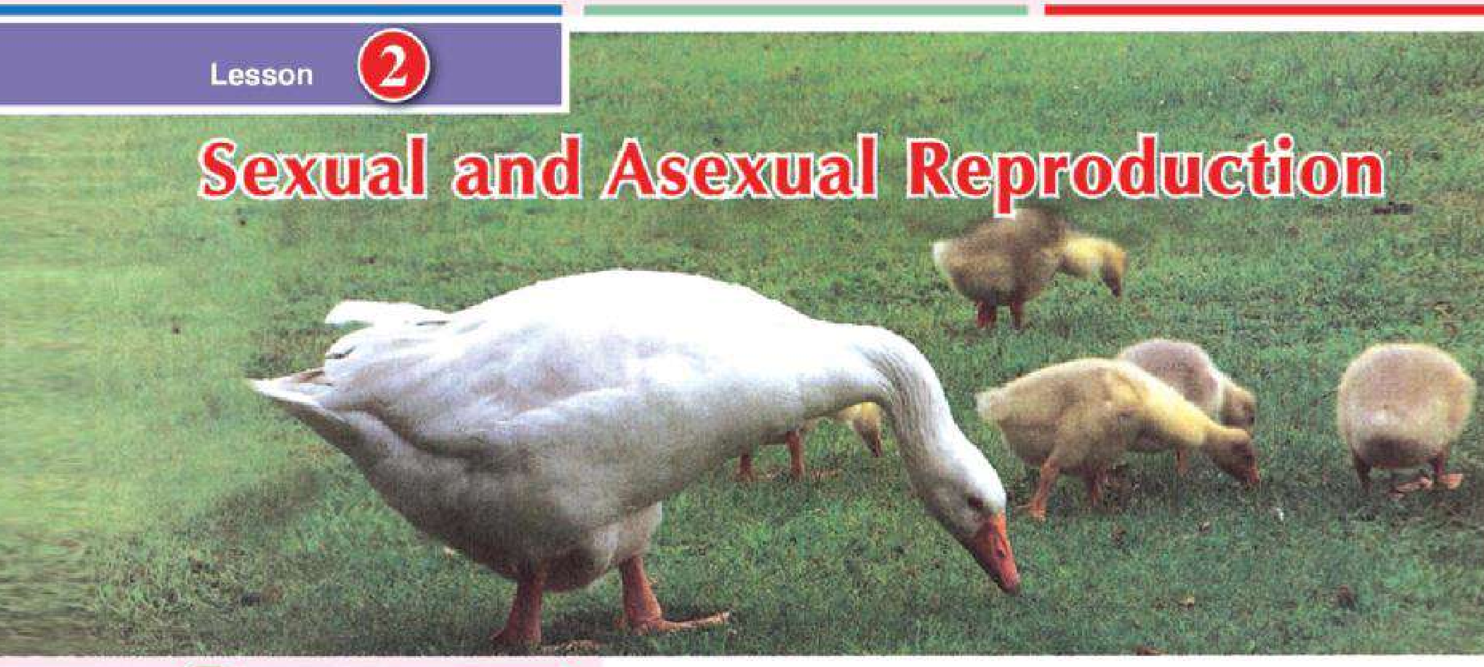
- It contributes in genes (that carry genetic traits) exchanging between the two homologous chromosome's chromatids and distributing them randomly in the gametes. This is an important factor for the variation of genetic traits among the individuals of the same species.

For extra activities and practice, go to MOE website.



Lesson 2

Sexual and Asexual Reproduction





Lesson objectives

By the end of this lesson, students should be able to:

- ✔ Identify the concept of asexual reproduction.
- ✔ Identify that asexual reproduction produces offspring identical to parents.
- ✔ Identify the concept of sexual reproduction.
- ✔ Identify that sexual reproduction is the source of genetic change.

Lesson terms

- Asexual reproduction.
- Binary fission propagation
- Budding.
- Regeneration.
- Spore.
- Vegetative propagation.
- Sexual reproduction.

Living organisms are characterized by their ability to reproduce. Reproduction is a biological process where the living organism produces new individuals of the same kind and thus, ensuring its continuity. In this process, the genetic traits move from parents to offspring.

Types of reproduction in living organisms:

1 Asexual reproduction:

- Asexual reproduction occurs by only one living organism. It mostly occurs in single-celled living organisms such as budding in a yeast and binary fission in Amoeba.

2 Sexual reproduction

- Sexual reproduction occurs in most higher living organisms of plants and animals. It occurs through two living organisms, one of them is a male and the other is a female.

First: Asexual reproduction

Asexual reproduction usually occurs in unicellular living organisms and also occurs in some multicellular animals and plants، where a living organism produces new individuals that have genetic traits identical to the parents. Asexual reproduction includes **mitosis** and does not require special systems or structures in the living organism. The following are some types of asexual reproduction.

Types of asexual reproduction

1 Binary fission

- It is a type of the asexual reproduction that occurs in unicellular living organisms. The nucleus is divided by **mitosis** and then the cell which represents the body of the unicellular organism splits into two cells each one becomes a new individual.
- This type of division occurs in unicellular protozoans such as Amoeba, Paramecium and Euglena and also in simple algae and bacteria.

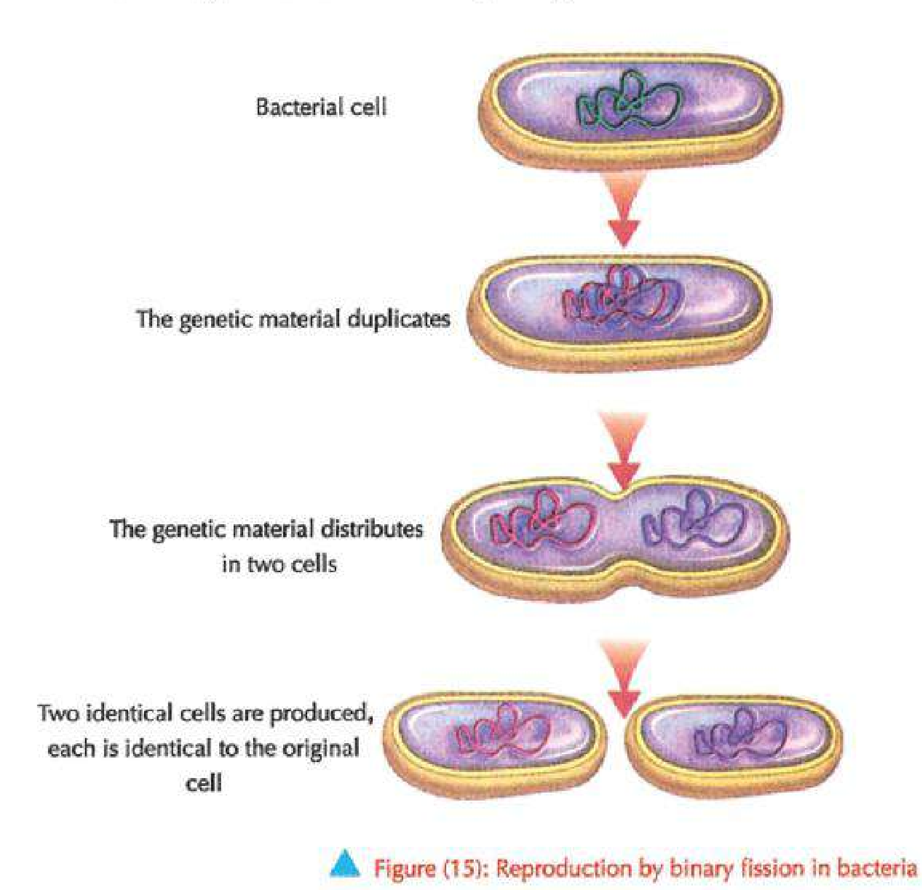


Figure (15): Reproduction by binary fission in bacteria

❷ Budding :

It is one of the asexual reproduction types that occurs in unicellular living organisms (such as yeast fungus) and multi-cellular organisms (such as Hydra and Sponges)



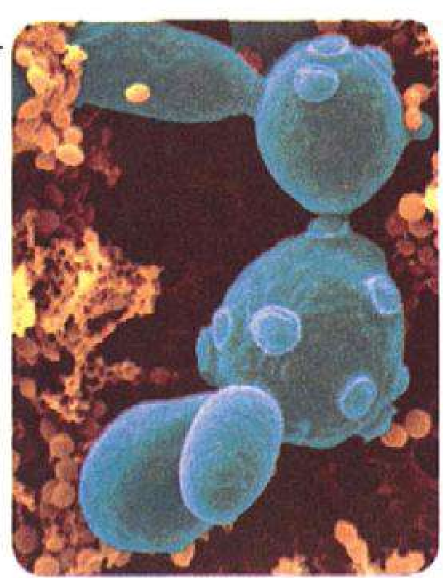
Discover how does yeast fungus reproduce.

Materials and tools :

A piece of yeast - sugar solution- warm water - microscope - a glass slide -cover slips – a teeth stick).

Procedures:

1. Add 1 ml sugar solution and 4 ml of warm water to 2 ml yeast in a plate and leave them for ten minutes in a warm dark place.
2. Take some of the mixture and place it on a glass slide. Place the cover slip gently.
3. Examine the slide under the microscope and record what do you observe.
4. Compare what do you observe with the opposite figure.



▲ Figure (16): Budding in the yeast

In the previous activity, you observe the following:

- In yeast, the bud emerges as a lateral bulge in the cell, then the cell nucleus is divided (by mitosis) into two nucleoli. One of them remains in the parental cell and the other immigrates to the bud.
- A bud grows gradually and remains connected to the parental cell until it is fully grown then separates from it or remains to form a colony.

3 Regeneration :

- Regeneration is the ability of animals to compensate their missing parts. The living organism can reproduce by one of its parts. Starfish arms could be regenerated and give out a complete animal if they contain a part of the central disc of the animal.



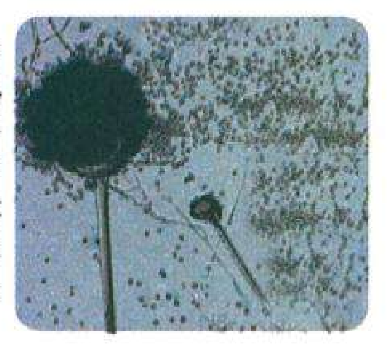
▲ Figure (17) Starfish with many arms arises from a central disc part

Question for thinking

- If the number of chromosomes in a starfish mother cell is (2N), how many chromosomes are there in the cells resulted by regeneration? Why?

4 Sporogony(Spore propagation)

- It is a type of asexual reproduction which is more common in some fungi such as bread mould, mushroom and some algae, where they have special organs called sporangia (a singular sporangium). Each sporangium has a large number of spores that release after rupturing its wall. When spores find a suitable environment, they start growing to give out a new organism.



▲ Figure (18): Release of spores from the sporangium of bread mould fungus.

5 Vegetative (reproduction)

- You already studied that plants reproduce vegetatively without needing seeds by their vegetative organs such as leaves, roots and stems, and the cells (tissues culturing) in order to produce new plants very similar to the parent plant. Vegetative propagation in plants includes cell's mitotic division.

From the above, you see that the asexual reproduction produces offspring identical to their parents.

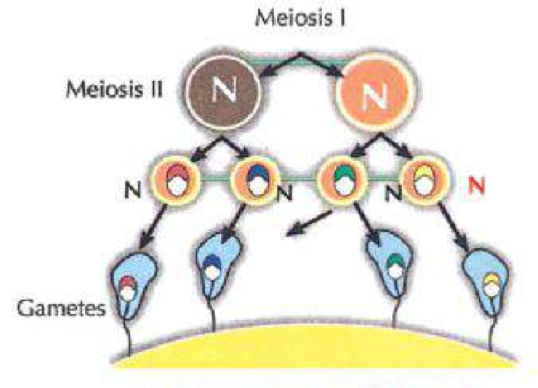
Asexual reproduction in living organisms produces individuals identical in genetic structure with the original organism. The similarity in the genetic structure of the resulted offspring is caused by (mitosis). The new offspring gets a full copy of the parental individual's genetic traits. Thus, no genetic variations occurred causing difference in the resulting offspring from the original organism.

Second: Sexual reproduction

It is the most common type of reproduction especially in the higher living organisms. Sexual reproduction occurs between two parental individuals. One of them is a male and the other is a female. Sexual reproduction depends on two main processes: formation of gametes and fertilization.

Formation of gametes

- Gametes in organisms are formed of cells known as reproductive cells by the meiotic division (reduction division). Gametes resulted from this division contain half the number of chromosomes (N) of organism's somatic cells.



▲ Fig (19): Meiosis and gametes formation

Fertilization : (Fig 20)

- It means the combination of the male gamete (N) and female gamete (N) to form a zygote (2N) which contains the normal number of chromosomes of the organism. This zygote contains genetic material from each parent. When it grows, it gives a new offspring whose traits combine each parent's traits.

Sexual reproduction is a source of genetic variation:

- The offspring resulting from sexual reproduction get the genetic traits from two sources; one of them is the male parent and the other is the female parent. This means that the resulted offspring have new genetic traits that combine the parent's traits. Thus, sexual reproduction is a source of genetic variation.



▲ Fig (20): Sperms surround the ovum before fertilization

For extra activities and practice, go to MOE website.





Science, Technology and Society

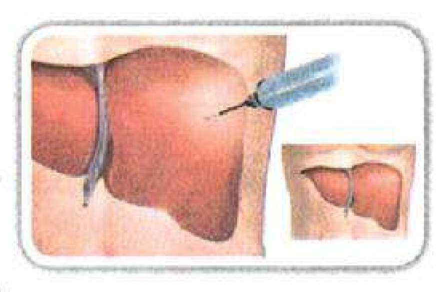
Technological application

Nanotechnology and cancer treatment

- Cancer occurs when the body cells are divided continually without controlling. The mass resulted from this division is called the tumor. Using nanotechnology, scientists have developed smart microscopic bombs that penetrate the cancer cells and explode them from the inside. They were used to kill the cancer cells in an experimental mice. Mice suffered from cancer were able to live 300 days after this treatment. As for mice that did not receive treatment, they did not live more than 43 days.
- The Egyptian scientist Dr. Mustafa El Said discovered a way to detect the cancer cells. This technical starts by loading proteins (they have the ability to attach to the cancerous cell secretions) with NANO- molecules of gold and then injecting them into the patient. The infected cell surface proteins get intertwined with the golden molecules to make it possible to monitor the infected cells through a microscope; each cell separately.
- The method of treatment is focusing laser with a certain degree to the gold molecules. Then it absorbs the light and converts it into heat which leads to burn and kill the infected cells that has stuck to them.

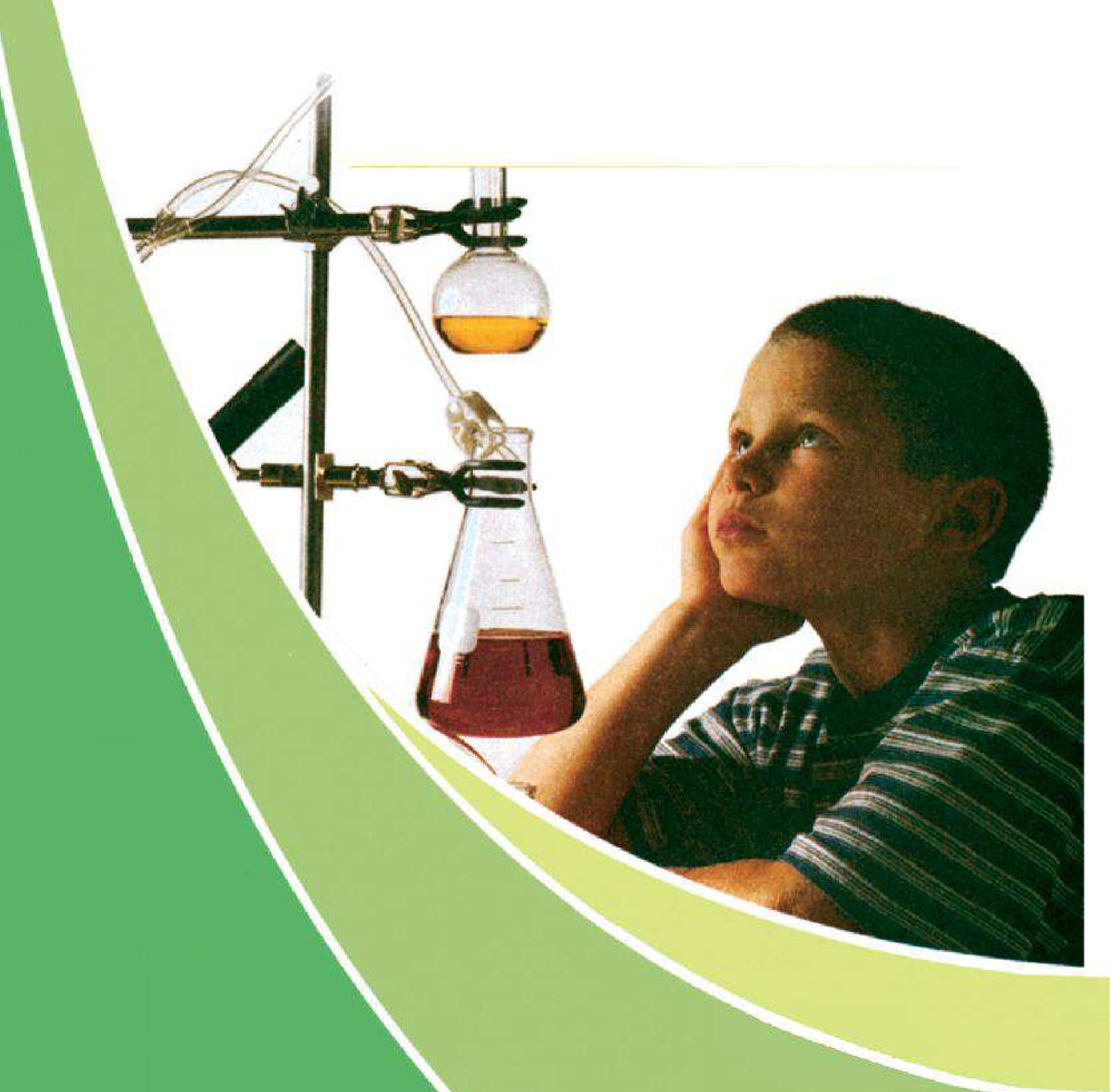
Technological application

Liver Transplantation



- Some cells in the human body are not divided at all such as nerve cells and red blood cells. Some cells are not divided in normal conditions but they retain the ability to divide under certain circumstances such as liver cells. For example, if the liver gets injured or a part of it is cut, the remaining cells undergo division so as to compensate the missing part. This is the scientific basis used in liver transplantation.

Second Term

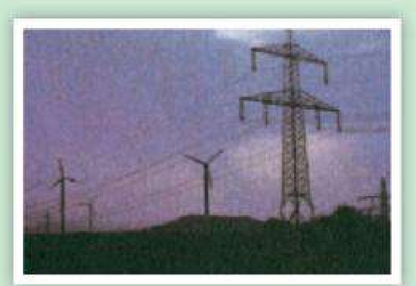


CONTENTS

Unit 1 : Chemical Reaction



Unit 2 : Electric Energy and Radioactivity



Unit 3 : Genetics



Unit 4 : Hormones



Safety in Science

Scientists know they must work safely when doing experiments. You need to be careful when doing experiments too. Here are some safety precautions to remember.

Safety Tips

- ✔ Read each experiment carefully.
- ✔ Wear safety goggles when needed.
- ✔ Clean up spills right away.
- ✔ Never taste or smell substances unless directed to do so by your teacher.
- ✔ Handle sharp items carefully.
- ✔ Tape sharp edges of materials.
- ✔ Handle thermometers carefully.
- ✔ Use chemicals carefully.
- ✔ Dispose of chemicals properly.
- ✔ Put materials away after you finish an experiment.
- ✔ Wash your hands throughly after each experiment.



Second Term - Unit One

Chemical Reactions

Introduction

Biological process inside the human body are a group of biochemical reactions that aim to keep life according to fixed systems. Also, processes performed at factories which aim to produce different materials needed in life are chemical reactions.

So, industerial and agricaltural productions, the continuation of living organisms and even the fuel inside Earth are all chemical reactions.

UNIT OBJE CTIVES



By the end of this unit, you will be able to :

- ✓ Identify the different types of chemical reactions.
- ✓ Distinguish between the reactions of thermal decomposition, simple and double substitution.
- ✓ Identify the concepts of oxidization, reduction, and concepts of oxidizing and reducing agents.
- ✓ Identify the concept of the speed of the chemical reaction.
- ✓ Identify the factors affecting the speed of the chemical reaction.
- ✓ Deduce the effect of both (the nature of reactants, concentration, temperature and catalysts) on the speed of a chemical reaction.
- ✓ Evaluate the importance of chemical reactions in our life.

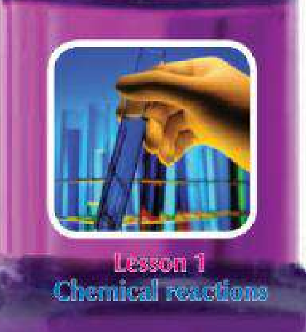
Included issues

Conservation of resources

Integrating Sciences



- Biology : through identifying the role of enzymes.



Lesson 1
Chemical reactions



Lesson 2
Speed of the chemical reaction

Lesson 1

Chemical Reactions





Lesson objectives

By the end of this unit, you will be able to :

- ✓ Identify the types of chemical reactions.
- ✓ Distinguish between thermal decomposition, simple and double substitution reactions.
- ✓ Identify the concepts of oxidization, reduction, oxidizing agent and reducing agent.



Lesson terms

- Thermal decomposition reactions.
- Simple substitution reactions.
- Double substitution.
- Oxidization.
- Reduction.

Chemical reactions have a great importance in our life. For example, When gasoline is burnt in the car engines, it generates a power which makes move. Another example, plants food is produced by the photosynthesis process which depends mainly on the reaction of carbon dioxide with water.

Different types of medicines, fertilizers and artificial fibers are examples of the chemical products .

Chemical reaction is the breaking up of bonds in reactant molecules and the formation of new bonds in the products molecules .

Are all chemical reactions similar?





▲ Figure (1) : Chemical reactions occur in many aspects in our life.

Chemical reactions are different according to the processes which include and can be classified into many types.

First: Thermal decomposition reactions.

In this kind of chemical reactions, the compound decomposes by heat into its simple components. It may decomposes completely into its simple elements or a more simpler compounds.

Decomposition reactions can be represented using paper clips as in the following figure:

▲ Figure (2) : Representation of thermal decomposition reactions.



Discover :

Some Substances decompose by heat

Tools:

Red mercuric oxide – copper hydroxide – copper carbonate – copper sulphate – sodium nitrate – test tubes – flame – matches-test tube holder .

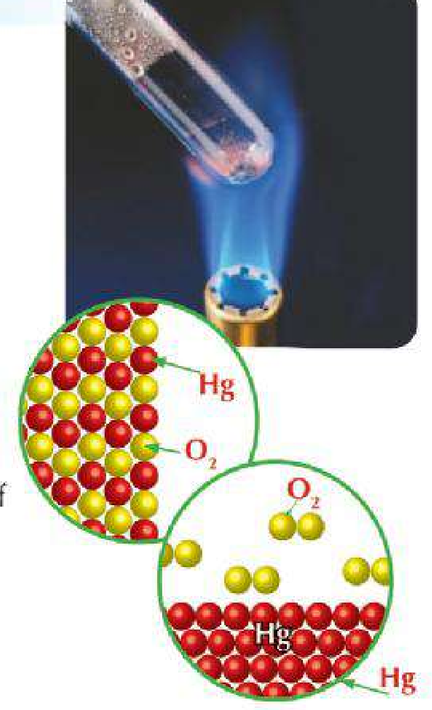
Procedures:

1. Put a little amount of mercuric oxide in a test tube.
2. Heat the mercuric oxide.
3. Get the lightened stick of matches close to the mouth of the tube.

What do you notice?

....

4. Repeat the previous steps with the other compounds.
5. Record your observations about each compound.



▲ Figure (3) : Thermal decomposition of red mercuric oxide

- Some metal oxides decompose by heat into the metal and oxygen. Red mercuric oxide decomposes by heat into mercury (silvery) which preciptates at the bottom of the tube and oxygen that evolves at the mouth of the tube. This causes the glowing of the match stick.

$$2HgO \xrightarrow{\Delta} 2Hg + O_2 \uparrow$$

- Also, some metal hydoxides decompose when heated into metal oxide and water vapor. Blue copper hydroxide decomposes by heat into copper oxide (black) and water vapor.

$$Cu(OH)_2 \xrightarrow{\Delta} Cu\,O + H_2O \uparrow$$

- Most metal carbonates decompose by heat to metal oxide and carbon dioxide. Green copper carbonate decomposes by heat to black copper oxide and carbon dioxide.

$$CuCO_3 \xrightarrow{\Delta} CuO + CO_2 \uparrow$$

- Most metal sulphates decompose when heated to metal oxide and sulphur trioxde. blue copper sulphate decomposes by heat into black copper oxide and sulphur trioxide.

$$CuSO_4 \xrightarrow{\Delta} CuO + SO_3 \uparrow$$

- Some metal nitrates decompose by heat and oxygen gas evolves . White sodium nitrates decompose by heat into yellowish white sodium nitrite and oxygen.

$$2NaNO_3 \xrightarrow{\Delta} 2\,NaNO_2 + O_2 \uparrow$$





Figure (4) : Copper hydroxide (blue coloured) decomposes by heating into copper oxide (black coloured)

Second: Substitution reactions

Substitution reactions occur when there is an active metal that replaces another less active metal in an another compound.

These reactions are identified by knowing the more active elements in the series of chemical activity. The series of chemical activity is an arrangement of the metals in a descending order according to their chemical activity. The element which is more active substitutes the less active one.

All elements above hydrogen in the series replace hydrogen in acid solutions, whereas the elements that follow hydrogen do not replace hydrogen in acids except under certain chemical conditions.

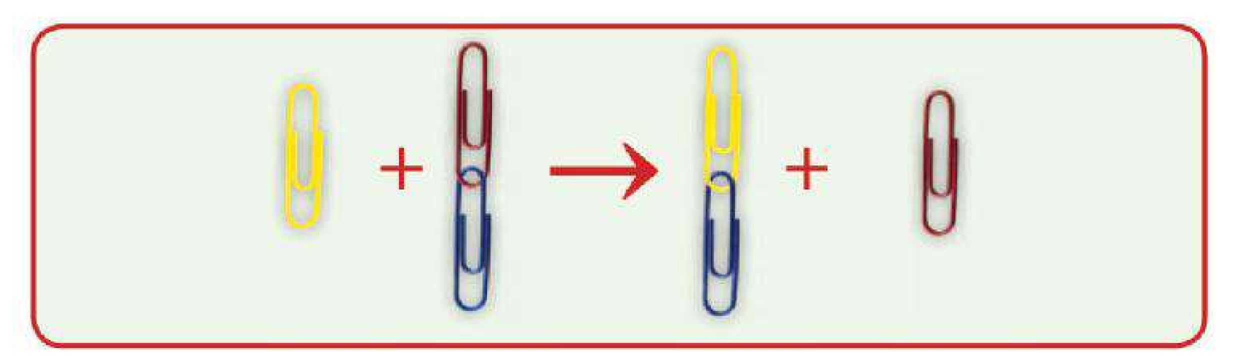
Element	Symbol
Potassium	K
Sodium	Na
Barium	Ba
Calcium	Ca
Magnesium	Mg
Aluminum	Al
Zinc	Zn
Iron	Fe
Tin	Sn
Lead	Pb
Hydrogen	H
Copper	Cu
Mercury	Hg
Silver	Ag
Platinum	Pt
gold	Au

▲ Figure (5) : The series of chemical activity

Substitution reactions are classified into two types:

a Simple substitution reactions:

- They are reactions in which an element replaces another one that the substituting element is more active than the substituted one.
- Substitution reactions can be represented by paper clips as follows:



▲ Figure (6) : Representation of simple Substitution reactions



A Metal substitutes the hydrogen of water or an acid :

Metals substitute hydrogen of water to produce metal hydroxide and hydrogen evolves as soon as metals substitute hydrogen of an acid forming acid salt and hydrogen gas evolves.

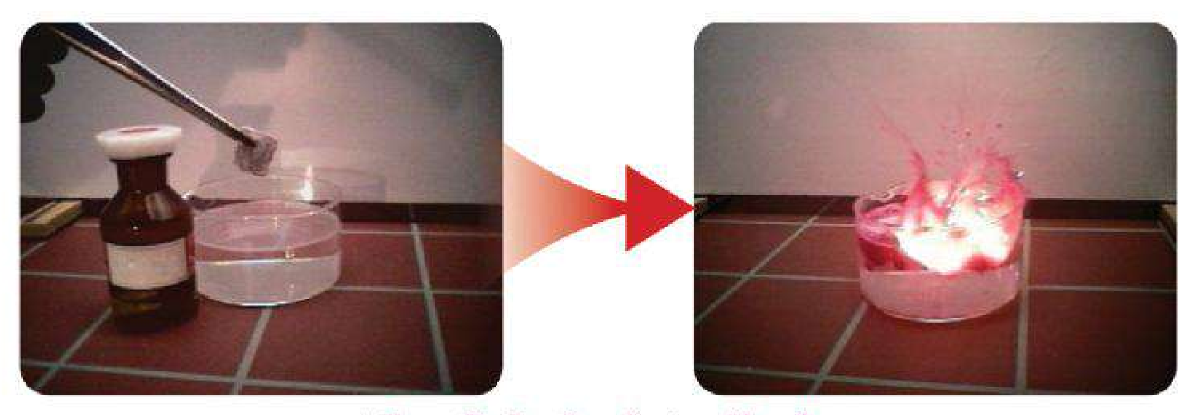


Activity **Discover :**

The reaction of water with sodium

Tools:

A very small piece of sodium – a glass of water - tongs



▲ Figure (7) : Reaction of water with sodium

Procedures:

- Place the very small piece of sodium in the glass of water by using tongs.

What do you notice?

....

....

What do you observe?

....

....

The reaction equation is :

$$2\ Na + 2\ H_2O \rightarrow 2\ NaOH + H_2\uparrow + heat$$

Metals react with water as they substitute hydrogen of water to produce the metal hydroxide and hydrogen evolves .

Be alert

Important Notice

- Be careful when performing this reaction as this will lead to explosion and ignition.

Put a very small piece of sodium keept under the kerosine.

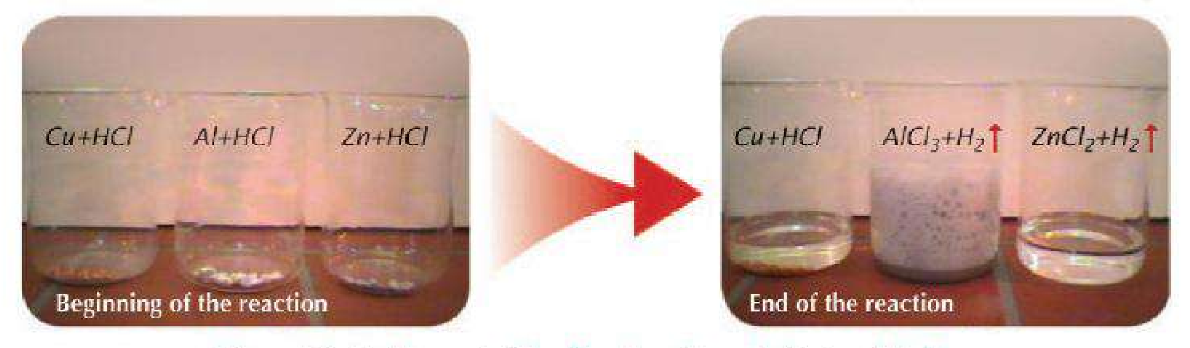


Discover :

A metal substitutes the hydrogen of an acid

Tools:

Diluted hydrochloric acid - 3 beakers - zinc - aluminium turning - copper turning



▲ Figure (8) : Metals react with acids where they substitute acid hydrogen

Procedures:

1. Put a little amount of zinc in a beaker, put a few aluminium turning in the second one and a few copper turning in the third one.
2. Add a little diluted hydrochloric acid to each beaker.

What do you observe?

....

- What do you observe in the Zinc beaker ? ....
- What do you observe in the aluminium beaker?..................................
- What do you observe in the copper beaker? ....

After a while

- What do you observe in the aluminium beaker? ....
- Does a reaction occur with the copper turning? ....

On adding dilute hydrochloric acid, it does not react with copper whereas it reacts with zinc immediately composing a salt and hydrogen gas evolves.

$$Cu + Hcl \xrightarrow{dil} \text{No reaction}$$

$$Zn + 2HCl \xrightarrow{dil} ZnCl_2 + H_2\uparrow$$

After short period of time Alumimium starts the reaction producing salt and hydrogen gas, although the Alumimium is before Zinc in the chemical activity series, Aluminium practically lates in its reaction with hydrochloric acid due to the presence of Aluminium oxide layer which isolates Aluminium from the acid, this layer takes a period to separate from metal and then metal exposes to reaction.

$$2Al + 6HCl \xrightarrow{dil} 2AlCl_3 + 3H_2\uparrow$$



A Metal substitutes another metal in one of its salt solution.

- Some metals replace another metals that follows it in the series of chemical activity in one of its salt solution.



Discover :

Substitution of a metal instead of another one in one of its salt solution .

Tools:

Beaker - blue copper sulphate solution - pieces of magnesium

Steps :

- Put the pieces of magnesium metal in the beaker of blue copper sulphate.

Notice changes that occur :

....



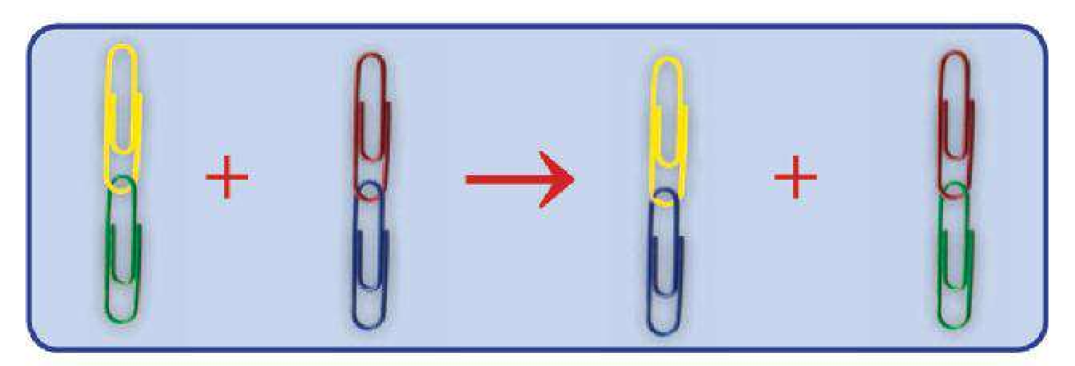
▲ Figure (9) : Substitution of a metal instead of another one in one of its salt

Magnesium is more active than copper. Thus, it substitutes copper in copper sulphate solution. A red copper precipitates in the beaker and the solution turns to magnesium sulphate.

$$Mg + CuSO_4 \rightarrow Mg\,SO_4 + Cu \downarrow$$

b Double substitution reaction

- It is a reaction where en exchange occurs between the ions of two compounds to form two new compounds. During this reaction, substitution occurs between reactants. Each element replaces the other to form two compounds different from the elements in the reactants.



▲ Figure (10) : Representation of double substitution reaction

Double substitution reactions are classified into:-

1 Reaction between an acid and an alkali (neutralization)

- It is the reaction between an acid and an alkali forming salt and water .

Acid + Alkali $\rightarrow$ Salt + Water

For example, when hydrochloric acid reacts with sodium hydroxide, they produce sodium chloride (salt) and water. On heating the solution, water evaporates and sodium chloride remains.

$$NaOH + HCl \rightarrow NaCl + H_2O$$

2 Reaction of an acid with a salt

- Acids react with salts and the resultant depends on the type of both the acid and salt.



Discover :

The reaction of hydrochloric acid with sodium carbonate

Tools:

Hydrochloric acid - Sodium Carbonate powder - beaker contains a clear lime water - plastic bottle - a balloon

1. Put an amount of hydrochloric acid in a bottle.
2. Put some amount of sodium carbonate in a balloon.
3. Insert the top of the balloon over the mouth of the bottle.
4. Slowly turn over the balloon in a way that makes the amount of sodium carbonate fall into the bottle

What do you observe inside the bottle?

....

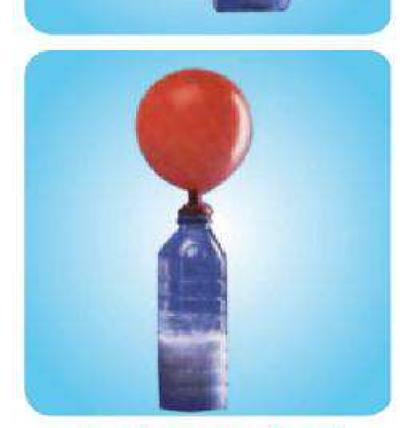
What do you observe about the appearance of the balloon?

....

5. Carefully close the balloon and take it away of the bottle.
6. Pass the gas collected inside the balloon into a clear lime water.

Hydrochloric acid reacts with sodium carbonate forming sodium chloride, water and carbon dioxide gas which turbids lime water.

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2\uparrow$$



▲ Figure (11) : Reaction of hydrochloric acid with sodium carbonate and CO_2 evolves.

3 Reaction of a salt solution with another salt solution

- Double substitution reactions between salt solutions are accompanied by the formation of a precipitate.
- When we add silver nitrate solution to sodium chloride sloution , a white precipitate of silver chloride is formed

$$NaCl + AgNO_3 \rightarrow NaNO_3 + AgCl \downarrow$$

C Oxidization and Reduction

- When hydrogen passes through hot copper oxide, hydrogen takes the oxygen away from copper oxide and water is formed. Copper oxide turns into copper.

$$H_2 + CuO \xrightarrow{\Delta} Cu + H_2O$$

- During this reaction, the hydrogen is oxidized because it got united with oxygen. On the other hand, copper oxide was reduced because oxygen is taken away from it.
- We can say that copper oxide is an oxidizing agent because it oxidized hydrogen. But hydrogen is a reducing agent because it reduced copper oxide to copper.

Oxidization	A chemical process which increases oxygen percentage or decreases hydrogen percentage in substance .	Reduction	A chemical process which decreases oxygen percentage or increases of hydrogen percentage in a substance.
Oxidizing agent	It is the substance which gives oxygen or takes away hydrogen during a chemical reaction	Reducing agent	It is the substance which takes away oxygen or gives hydrogen during a chemical reaction

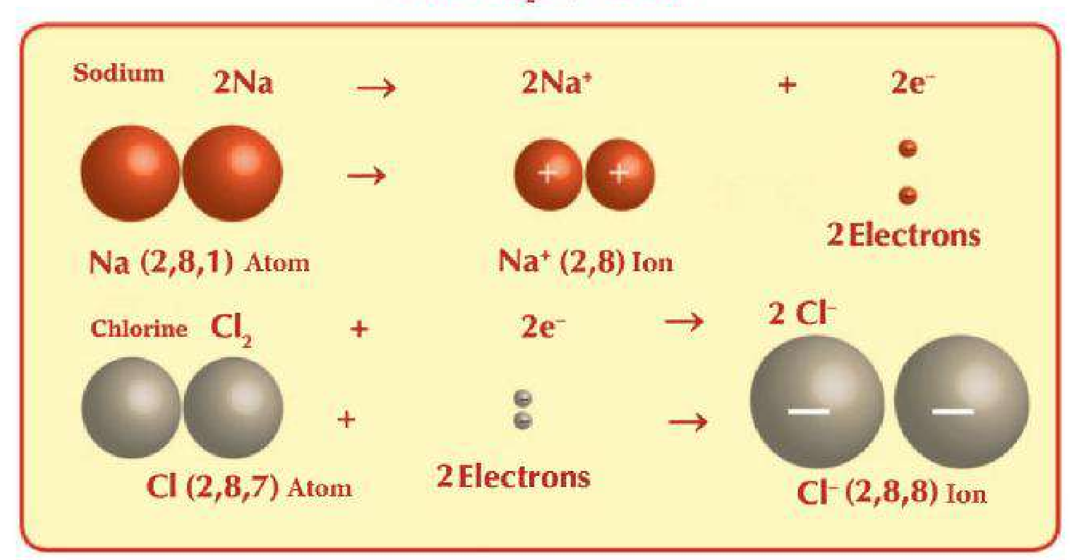
- There are chemical reactions which include both oxidization and reduction processes although the absence of oxygen or hydrogen .
- The reaction of sodium with chlorine includes both oxidization and reduction processes. This reaction gives sodium chloride which is known as table salt.



▲ Figure (12) : Extraction of table salt from water of lakes

You have already learnt that sodium is monovalent because it loses one electron forming a positive sodium ion (Na^+), whereas chlorine is also monovalent because it gains one electron giving a negative chloride ion (Cl^-), so. the following equation represents the previous reaction :

$$2Na + Cl_2 \rightarrow 2NaCl$$



Notice that in this reaction, sodium atom turns into a sodium ion, whereas chlorine atom turns into a chloride ion.

The sodium atom lost one electron and turned from a neutral atom to positive ion (+1). This process is called oxidization.

$$2Na \rightarrow 2Na^+ + 2e^-$$

electrons can not remain free, so they move to chlorine atom (gains electrons). and turns into a negative chloride ion (-1) . This process is called reduction.

$$Cl_2 + 2e^- \rightarrow 2Cl^-$$

Oxidization	A chemical process in which the atom loses an electron or more.	Reduction	A chemical process in which an atom gains one electron or more.
Oxidizing agent	It is the substance which gains an electron or more during a chemical reaction.	Reducing agent	It is the substance which loses one or more electrons during a chemical reaction.

Notice that the two processes of oxidization and reduction are concurrent processes.

For extra activities and practice, go to MOE website.

Lesson 2



Rate of Chemical Reactions



Lesson objectives

By the end of this unit, you will be able to :

- Identify the concept of the rate of a chemical reaction.
- Determine the factors which affect the rate of a chemical reaction.
- Deduce the effect of the nature of reactants, concentration, temperature and catalyst on the rate of chemical reactions.
- Aware that foods spoil by oxidation when left exposed.



Lesson terms

- Rate of chemical reaction.
- Reaction temperature.
- Catalyst.

The chemical reaction is a process in which a chemical substance turns to another one.

Chemical reactions differ in the time they take to occur. For example, some reactions take very short time like fireworks. Some reactions are a relatively slower like the reaction of oil with caustic soda. there are some reactions are slowest and need several monthes to take place such as the formation of the iron rust. Other reactions may take mellions of years like those which occur inside the Earth to form oil.

What is the speed of chemical reaction?
What are the factor affecting it?



▲ Figure (13) : Iron rust is a very slow chemical reaction



▲ Figure (14) : A firework is a fast chemical reaction

The definition of the speed of chemical reaction

To identify the meaning of the speed of a chemical reaction, we will study the following equation:

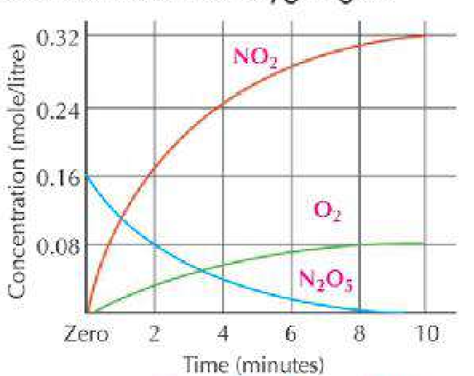
Nitrogen pentoxide breaks up into nitrogen dioxide gas and oxygen gas according to the following equation:

$$2\,N_2O_5 \rightarrow 4NO_2 + O_2$$

Oxygen atoms are collected together to form molecules that evolve. The following graph illustrates the rate of the dissociation of nitrogen pentoxide with time. The concentration (mole/litre) is represented on the vertical axis while time (minute) is repesented on the horizontal axis :

* The blue graphical line represents the change in the concentration of nitrogen pentoxide gas.
* The red grahphical line represents the change in the concentration of nitrogen dioxide gas.
* The green graphical line represents the change in the concentration of oxygen gas.

We notice that at the start of the reaction, the concentration of nitrogen pentoxide is 0.16 mole/litre, i.e 100%, while the concentration of both nitrogen oxide and oxygen is zero%. As time passes, the concentration of nitrogen pentoxide starts to decrease whereas the concentration of both nitrogen dioxide and oxygen starts to increase. By the end of the reaction, the concentration of nitrogen pentoxide becomes zero mole/litre›i.e zero%, whereas the concentratoin of the both nitrogen dioxide and oxygen increases, i,e. 100% . The following graph illustrates the breaking up of nitrogen pentoxide across time.



▲ Figure (15) : A graph that illustrates the breaking up of the nitrogen pentoxide

Examine the graph carefully and complete the following table:

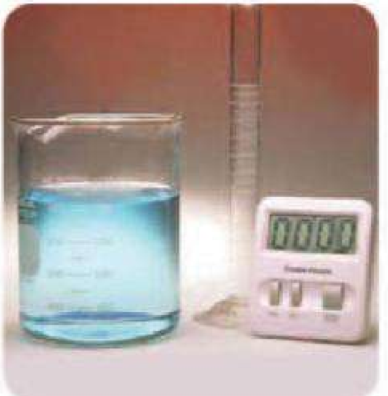
Time (minute)	The concentration of reactants (mole/litre)	The concentration of products (mole/litre)	
	N_2O_5	NO_2	O_2
Beginning of the reaction			
After two minutes			
After four minutes			
After eight minutes			
At the end of the reaction			

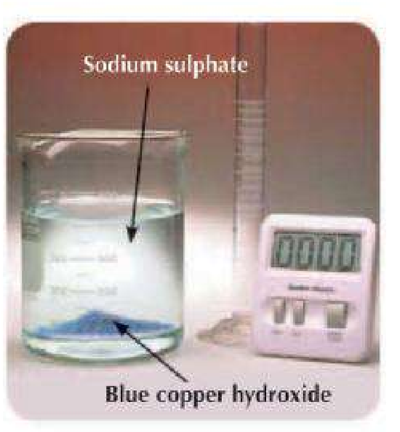
The speed of a chemical reaction can be defined as follows:

"The change in the concentration of the reactants and Products at a unit time "

The speed of chemical reaction can be practically measured by the rate of disappearance of a reactant or the rate of appearance of a products.







▲ Figure (16) :What happens to the color of solution as time passes ?

On adding sodium hydroxide to blue copper sulphate, colorless sodium sulphate forms and a blue precipitate of copper hydroxide is formed. The speed of this reaction is measured by the disappearance rate of copper sulphate color or the appearance rate of the precipitate.

Factors affecting the speed of chemical reaction

The speed of chemical reaction depends on many factors:

- The nature of reactants.
- The concentration of reactants.
- The temperature of the reaction .
- Catalysts.

a The nature of reactants

- The first factor which affects the speed of a chemical reaction is the nature of reactants. The nature of reactants includes the two following factors :
- The type of bonding in reactants.
- The surface area of reactants exposed to reaction.

1 Type of bonding in reactants

We find that:

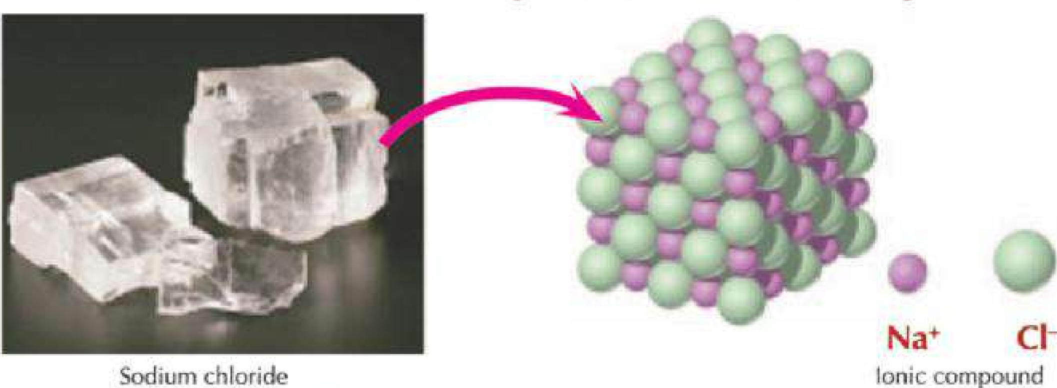
Covalent compounds:

They are slow in their reactien because they do not decompose to form ions. this reaction takes place between molecules.

Ionic compounds: they are fast in their reaction because they decompose into ions. The reaction take place between the ions such as the reaction of sodium chloride with silver nitrate. Each of the two compounds dissociat up into its ions and then the reaction occurs between these ions.

$$NaCl + AgNO_3 \rightarrow AgCl\downarrow + NaNO_3$$

$$Na^+ Cl^- + Ag^+ NO_3^- \rightarrow Ag^+ Cl^- + Na^+ NO_3^-$$



Sodium chloride

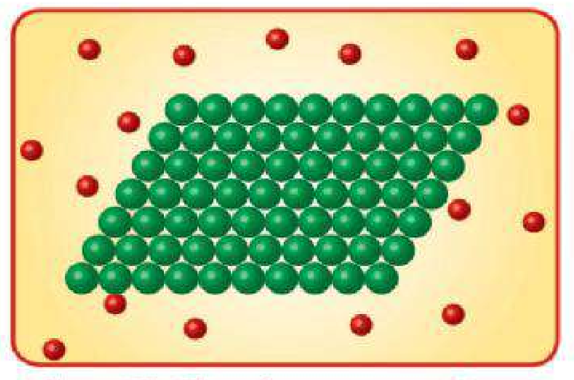
Ionic compound

▲ Figure (17) :Ionic compunds decompose into ions.

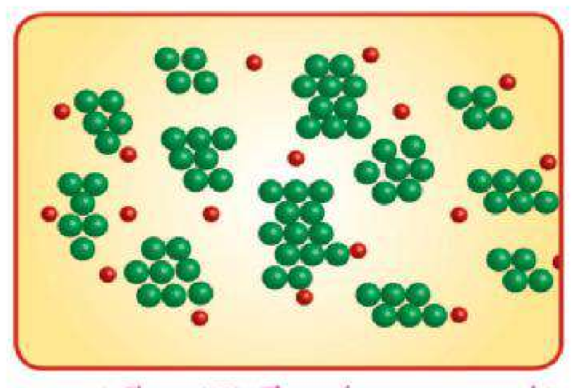


Surface area of reactants exposed to reaction

The surface area of the reactants exposed to the reaction affects the speed of the chemical reaction. The larger the area exposed to the reaction, the faster the chemical reaction is.



▲ Figure (18) : The surface area exposed to the reaction is small



▲ Figure (19) : The surface area exposed to the reaction is large

The area exposed to the reaction is small. The red colored molecules react only with the molecules of the outer layer and do not react with the molecules inside the bulk of the reactant. (Figure18)

When the reactant decomposes, the surface area exposed to reaction increases, So, the red colored molecules react with most of the molecules of the outer layer as well as that inside the bulk of the reactant (Figure19)

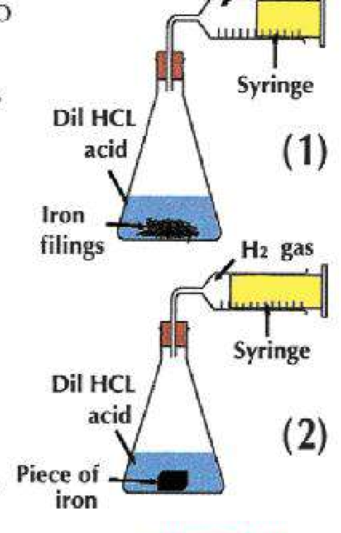


Discover :

Effect of surface area on the speed of a chemical reaction

Tools:

Two equal amounts of diluted hydrochloric acid Two equal masses of iron (one of them is iron filings and the other is one piece) – two conical flasks- two syringes



▲ Figure (20)

Procedures:

1. Put iron filings in conical flask (1) and the piece of iron in conical flask (2).
2. Put equal amount of diluted hydrochloric acid in both flasks.

What do you observe?

....

Which reaction is faster?

....

How can you explain this?

....

....

The rate of the reaction of hydrochloric acid with the iron filings is more faster than the piece of iron. This is because the area exposed to the reaction in case of the iron filings is more bigger than that in case of piece of iron. Thus, the reaction is completed in case of iron filings in shorter time than that of the iron piece.

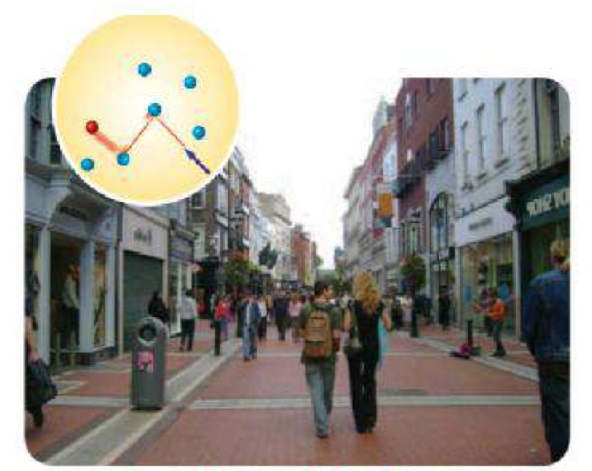
$$Fe + 2HCl \rightarrow FeCl_2 + H_2\uparrow$$

We can deduce that the speed of chemical reaction increases by the increase of the surface area exposed to reaction

Dr.Ahmed Zwail is an egyptian scientist who achieved Nobel Brize in chemistry in 1999 due to his awsome work in photographing the moments of the breaking up of bonds in reactants and the formation of new bonds by inventing a new LASER camera that capitures photos in a femtosecond. Use EKB to make a research on Dr .Ahmed Zwail his life and discoveries.then show what you gained with your classmates and teacher.

b Concentration of the reactants :

- One of the factors that increase the rate of a chemical reaction is the increase in the concentration of reactants. This increases the number of collisions between molecules and consequently the speed of the reaction increases.

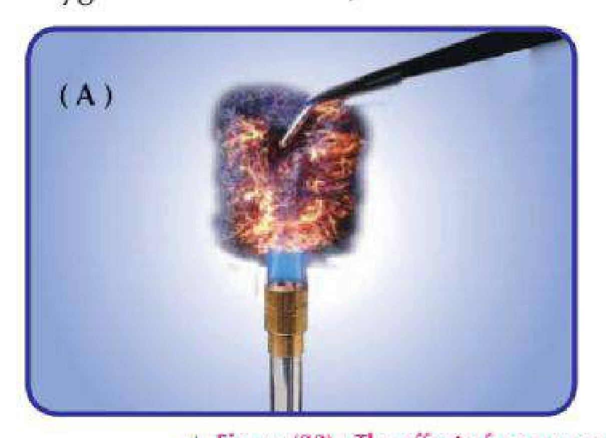


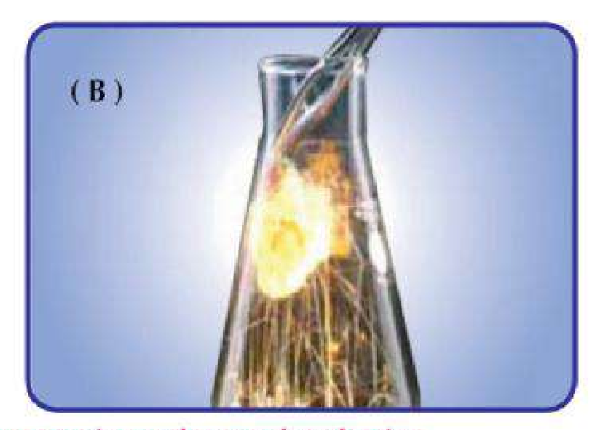
▲ Figure (21) : In a quiet street, the probability of collisions decreases like in the molecules of a substance with a low concentration



▲ Figure (22) : In a crowded street, the probability of collisions increases like the molecules of a substance with a high concentration

Figure (23) illustrates the effect of oxygen concentration on the rate of combustion. Figure (A) the combustion of the steel scource used for cleaning aluminium in oxygen in the air . Figure (B) the combustion in a jar which contains pure oxygen . The combustion of the steel scource used for cleaning aluminium in pure oxygen (high concentration) is faster than its combustion in oxygen in the air (less oxygen concentration) .





▲ Figure (23) : The effect of oxygen concentration on the rate of combustion



Discover :

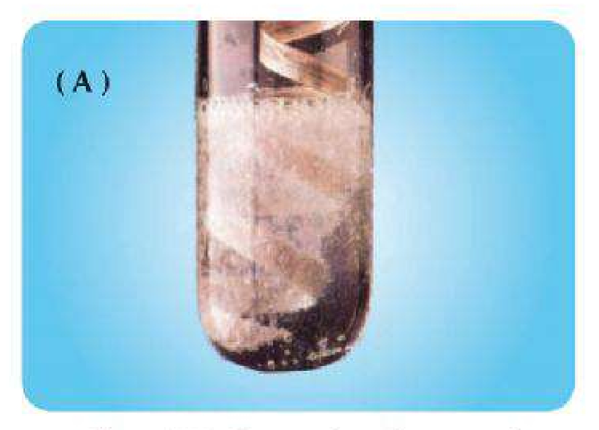
The effect of reactants concentration on the speed of the chemical reaction

Tools:

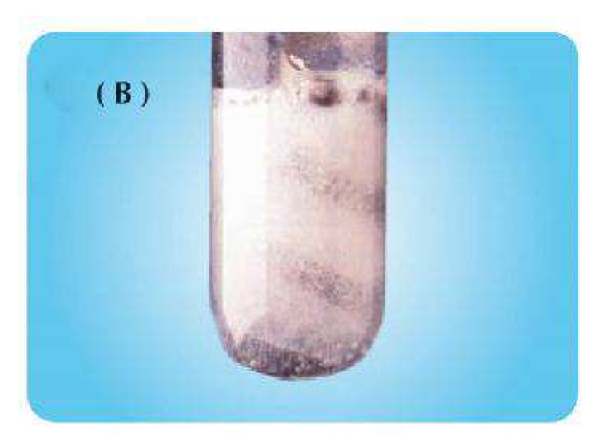
2 pieces of magnesium of the same size - 2 test tubes- diluted hydrochloric acid - concentrated hydrochloric acid - pipette .

Procedures:

1. Put an amount diluted hydrochloric acid in tube "A" and an equal amount of concentrated hydrochloric acid in tube "B" by used pipette.
2. Put a piece of magnesium in each tube



▲ Figure (24) : The reaction of a magnesium ribbon with diluted hydrochloric acid



▲ Figure (25) : The reaction of a magnesium ribbon in with concentrated hydrochloric acid

We can deduce through this activity that the speed of a chemical reaction increases as the concentration of the reactants increases.

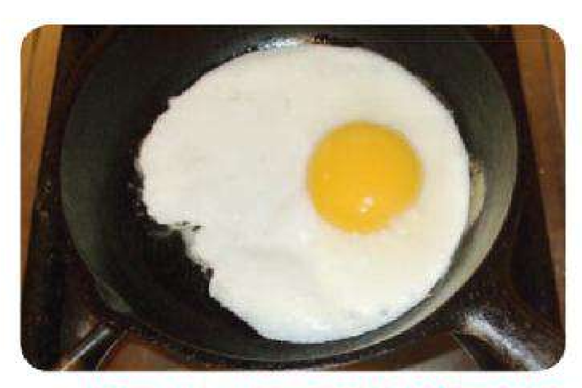
C The temperature of the reaction:

- which increases the number of collisions between molecules and consequently the rate of the reaction increases .Most of the chemical reactions speed up when the temperature increases

What do you do to preserve food for a long period of time? What do you do to cook food faster?



▲ Figure (27) : Food gets spoilt quickly if not frozen because of the chemical reactions done by bacteria. Cooling food at low temperature slows down those reactions.



▲ Figure (26) : If you want to cook eggs faster, you increase the temperature so as to increase the chemical reaction that helps in cooking food.



Activity

Discover :

The effect of temperature on the speed of chemical reactions

Tools:

2 similar beakers – 2 effervescent tablets – hot water – cold water

Procedures:

1. Fill half of the first beaker (A) with cold water and the second one (B) with hot water.
2. Add an effervescent tablet to each of the beakers.

What do you observe?

....

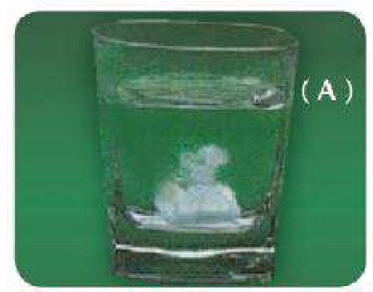
Which is faster in effervescence?

....

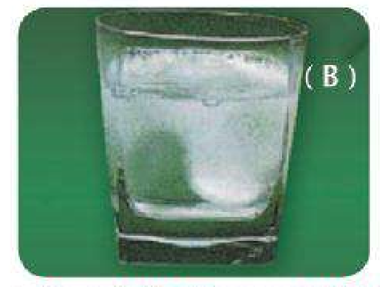
How can you explain this?

....

We can conclude that the speed of a chemical reaction increases when the temperature of the reaction increases.



▲ Figure (28) : Effervescent tablet in a glass of cold water



▲ Figure (29) : Effervescent tablet in a glass of hot water

d Catalysts

- A catalyst is a substance which changes the rate of the chemical reaction without being changed. Some chemical reactions are so slow but they speed up when a catalyst is added. Most catalysts speed up the chemical reaction and this is called a positive catalysts. Other catalysts are used to slow down a chemical reaction and this is known as a negative catalysts.

Catalyst has some characteristics which are :

1. it changes the rate of the reaction but do not affect either its beginning or stopping.
2. No chemical changes or decrease in mass occurs to the catalyst before or after the reaction.
3. it is bonded to reactants but get separated from them rapidly to form the resultants at the end of the reaction.
4. it decreases the energy needed for the reaction.
5. A small amount of the catalyst is often enough to complete the reaction.



Discover :
The decomposition of hydrogen peroxide

Tools:

Hydrogen peroxide – manganese dioxide – 2 test tubes.

Procedures:

1. Put an equal amount of hydrogen peroxide in the two test tubes.
2. Put a small amount of manganese dioxide in one tube of them.





▲ Figure (30) : Manganese dioxide helps in the increase of hydrogen peroxide decomposition speed.

What do you observe?

....

....

Which release more oxygen bubbles?

....

How can you explain this?

....

- The release of gas bubbles (oxygen gas) increases in the tube which contains manganese dioxide in respect to the other tube.
- Manganese dioxide acts as a catalyst increases of hydrogen peroxide decomposition speed.



Discover :

Effect of enzymes on speed of a chemical reaction

Tools:

Hydrogen peroxide – a piece of sweet potato – a glass beaker.

Procedures:

- Fill a half of the beaker with hydrogen peroxide.

What do you observe?

....

- Put the piece of the sweet potato in the beaker as in fig. (31).

What do you observe?

....

Which of the two cases produce more oxygen bubbles?

....

How can you explain this?

....



▲ Figure (31) : Oxidase enzme in potato helps in decomposition of hydrogen peroxide.

- Gas bubbels (oxygen gas) evolves.
- We can conclude that sweet potato includes a chemical substances (oxidase enzyme) helps in decomposition of hydrogen peroxide faster and oxgyen gas evolves this enzyme acts as catalyst.

Integrating Biology

- The human body contains thousands types of enzymes. Each type has a specific function. Without enzymes, man can never breathe, move, or even digest food.
- A molecule of one enzyme can do its task million times per minute. The reaction occurs in the presence of enzymes is more rapidly than that without their presence - thousands or even millions times.

For extra activities and practice, go to MOE website.



Enriching activity

Usage of sodium bicarbonate in your life

Polishing of a metal



- It is used in polishing silver by using a piece of aluminium foil, while washing so silver restores its shine.
- Any decorative metal pieces made of copper or chrome are rubbed with a cloth wet with water and immersed in sodium bicarbonate

In the Kitchen

- Add a little amount of it in the bottom of a waste basket before putting the bag to prevent the bad odaurs .
- Soak the legumes in water and add a little amount of sodium bicarbonate to help in decreasing the bloating that accompanies eating legumes.
- Add a little amount of sodium bicarbonate in the kitchen's sink and pour on it boiling water, and notice that the draining of the sink is faster.



legumes

In the garden

- Place sodium bicarbonate without any additives in the places where ants come out, and with time you will notice their disappearance.



Science, Technology and Society

Life Application



The catalytic converter

Most modern cars are equiped with a catalytic converter that helps in the treatment of harmful gases. It is composed of ceramic cells similar to bee cells, but they are covered with thin layer of a catalytic metal as platinum.

The idea of using this converter is based on the exposure of the largest part of the surface of the calalytic substance to the current of the emitted gases from the engine so as to economize the use of these metals .

Technological Application



Air bags

Car air bags are considered one of the most important safety means at emergencies. They are designed in a way that they get inflated at an extreme speed within only 40 mm second on the occurrence of the car crash with another object. Then, they get vacuumed rapidly to ensure both the motorist's clear vision and proper movement. This leads to the decomposition and explosion of sodium azid compound forming sodium and nitrogen that fills the air bag on crashing.

$$2NaN_3 \xrightarrow[\text{spark}]{\text{Electrical}} 2Na + 3N_2$$

The Second Term - Unit two

Electric Energy and Radioactivity

Introduction

Electricity is a hidden energy that can not accurately described. Yet, we identify it through its various effects and features. It is the light in the electric lamp that illuminate our nights. It is the heat of electric heaters and irons. It is the mechanical energy of engines. It is the sounds in the radio, cassette recorder and telephone. It is the waves that do different tasks. It is rays like the X-ray used in medical diagnosis. This is in addition to so many usages that Allah Almighty creates to serve man in life. Besides, it is a clean energy that does not pollute the environment.



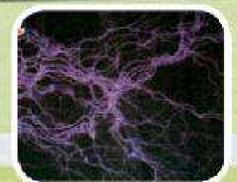
UNIT OBJECTIVES

By the end of this unit, will be able to :

- ✓ Identify the concepts of current intensity, potential difference and the electric resistance.
- ✓ Identify the instruments used for measuring the current intensity. potential difference and electric resistance.
- ✓ Identify the units for measuring the current intensity, potential difference and electric resistance.
- ✓ Identify some of the sources of the electric current.
- ✓ Compare between the alternating-current and direct-current.
- ✓ Compare between the methods of connecting the electric cells in electric circuits.
- ✓ Identify the phenomenon of radioactivity.
- ✓ List examples of radioactive elements.
- ✓ Identify the safe uses of the nuclear energy.
- ✓ Identify the harmful effects of radioactive pollution and the method of protection.
- ✓ Appreciate the importance of electric energy in ourlife throught its multiple applications.

Included issues

- Peaceful uses of energy.
- Protection from radiation.



Lesson 1
Physical properties of the electric current



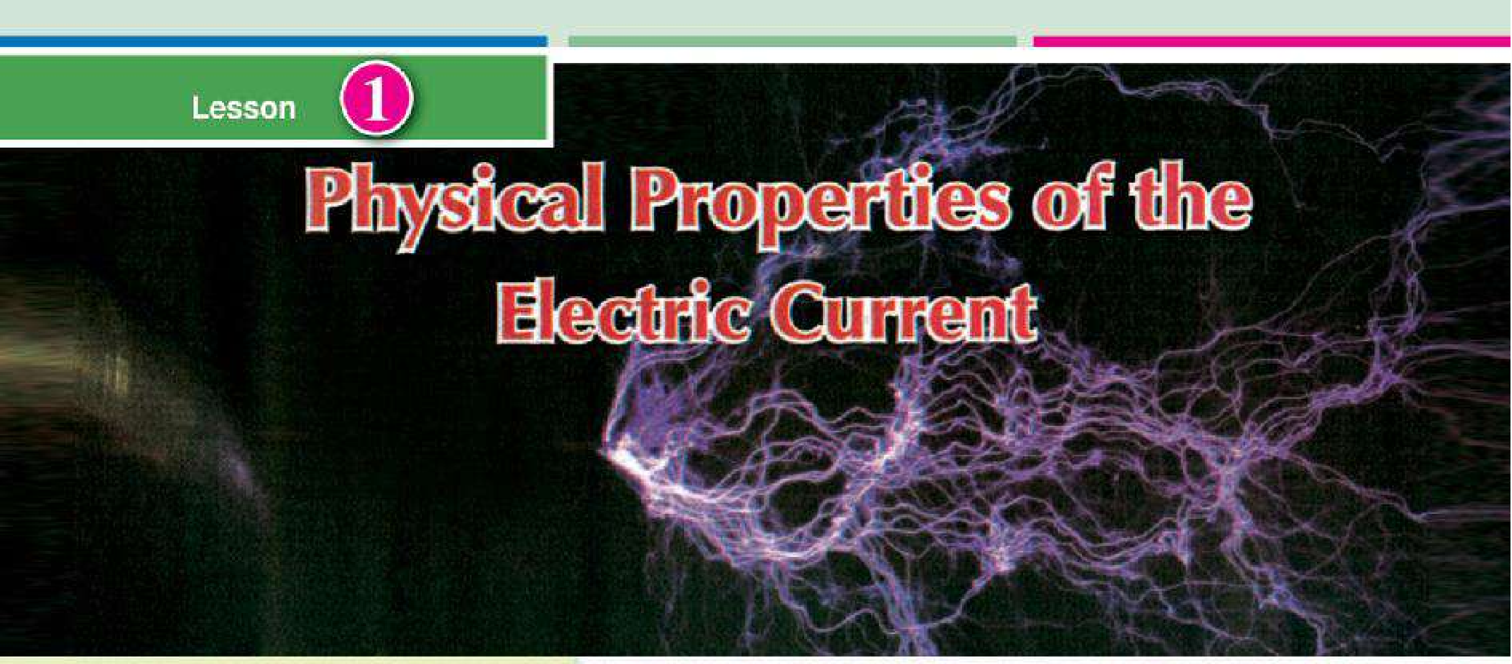
Lesson 2
Electric current and electric cells



Lesson 3
The radioactivity and the nuclear energy

Lesson 1

Physical Properties of the Electric Current





Lesson objectives

By the end of this lesson, you will be able to :

- ✓ Identify the concepts of the current intensity, the potential difference, and the electric resistance.
- ✓ Identify the instruments used for measuring the current intensity, the potential difference, and the electric resistance.
- ✓ Determine the units for measuring the current intensity, the potential difference, and the electric resistance.



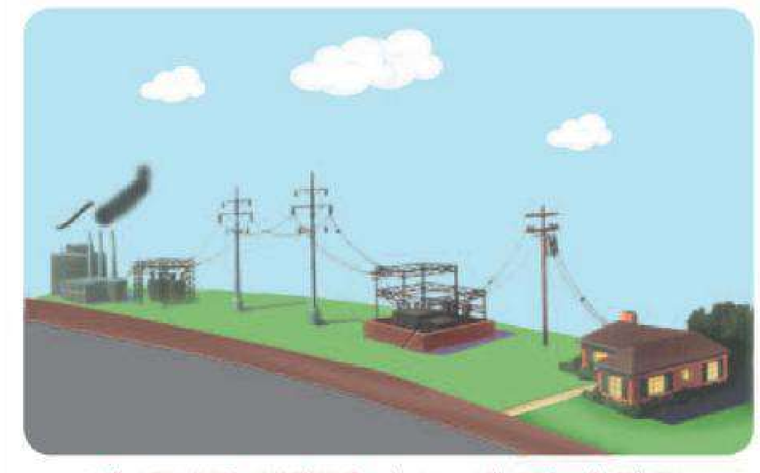
Lesson terms

- Electric current.
- Current intensity.
- Potential difference.
- Electromotive force.
- Electric resistance.

There is no doubt that you cannot live in your house without electricity. The electric appliances are around you everywhere. You will not be able to read this book at night unless you switch on the electric lamp, and you will not be able to switch on the radio and hear the news unless there was electric current. The same goes for all aspects of life.

You might know that the electric current is generated in electric power stations that are away from your house by hundreds or thousands of kilometers.

What is meant by the electric current ? How is it generated? How does it reach your house? What are its properties?



▲ Figure (1) : Connecting electric power from the electric power station to the houses

How is the electric current generated? What is meant by the electric current ?

You have previously studied the composition of the atom and knew that the protons are present in the nucleus while the electrons revolve around the nucleus in outer orbits affected by an attraction force (with the nucleus). in the absence of this attraction force, the electrons become free. On connecting a wire with an electric source, electrons move in the wires(conductors) creating the electic current. due to the potential difference in the circuit

Therefore, we can define the electric current as the flow of electric negative charges (the electrons) in a conducting substance (as a metal wire).

Question for thinking

If you pass an electric current in a circuit and the lamp lights up, is the intensity of light determined by the number of electrons passing in the wire?



▲ Figure (2) : The flow of electrons in the electric wire

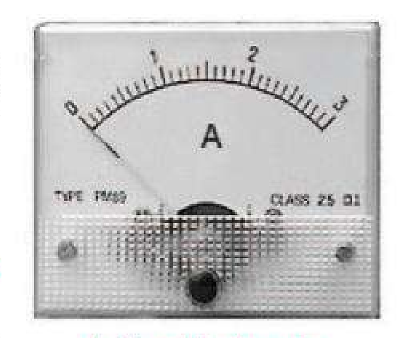
Physical propeties of the electric current:

There are several physical concepts of the electric current as the current intensity potential difference and resistance.

1 Current intensity (I) :

It is the quantity of electricity in Coulomb or the electric charges flowing through a cross - section of the conductor in one second.

coulomb:the charges which transmitted by a current with one ampere intensting in one second



▲ Figure (3) : Ammeter

How to measure the current intensity ? what are its measuring units?

It is measured by using instrument called an Ammeter that is symboled by the sign –(A)– when drawing electric circuits. The measuring unit of the current intensity is known as Ampere. We can define Ampere as a quantity of charge of 1 Coulomb passing through any cross - section of the conductor in one second.

$$\therefore \text{Current intensity (I)} = \frac{\text{Quantity of charge (coulomb) (Q)}}{\text{Time (second) (t)}}$$

Example :

- Calcutate the current intensity due to the flow of 5400 coulombs through a cross - section of a conductor for 5 minutes.

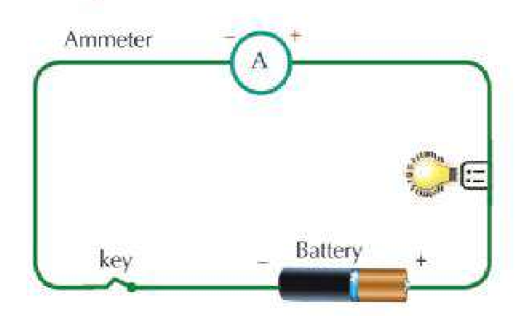
Solution: Time in seconds $= 5 \times 60 = 300$ s

$$\text{Current intensity} = \frac{\text{quantity of charge}}{\text{time}} = \frac{5400}{300} = 18 \text{ Amperes}$$



How is the Ammeter used? Why ?

1. Make a circuit as shown in figure (4).
2. Close the key of the circuit.



▲ Figure (4) : The Ammeter connected in an electric circuit

Observe:

What do you observe on the pointer of the ammeter?

....

What does the reading of the pointer of the ammeter indicate?

....

- We can conclude that Ammeter used to measure the electric current intensity and connected in an electric circuit on series

② The electric potential difference (V) :

What is meant by electric potential of a conductor ?

It is the state of an electric conductor that shows the transfer of the electricity from or to it ,when it is connected to another conductor.

In order to understand what the potential difference means, and how does electricity move from one conductor to another, try to understand the following example:

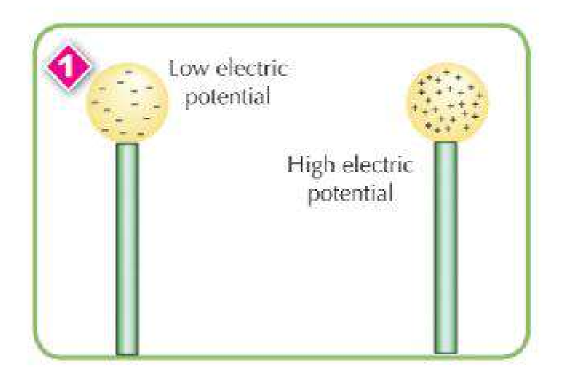
Heat transfers from a hot object (A) to a cold object (B) when they are connected with a metal rod (Figure 5), and it continues to transfer until the temperature of both objects becomes equal. The transference of heat does not depend on the size of the two objects, but on the difference in their temperatures. The temperature difference determines the transference of heat to and from an object.

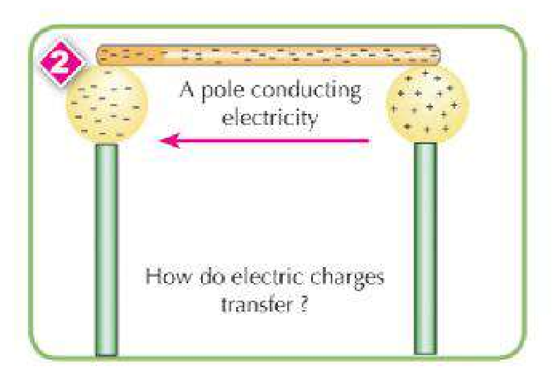


▲ Figure (5) : Heat transference by conduction

Similarly, for electricity:

The potential difference between two conductors determines the transference of the electric charges to and from an object when it is conducted to another conductor. If two charged conductors touch and the electric potential of one conductor is higher than the electric potential of the second (Figure 6) then the electric current will flow from the first conductor to the second conductor until their potential becomes equal. The transference of the charges does not depend on their amount, but on the conductor potential in comparison to the other conductor.





▲ Figure (6) : Flow of electric current depending on the potential difference between 2 conductors

We can define the potential difference between the two poles of a conductor as follows:

It is the value of the work done to transfer a quantity of electric charges of one Coulomb between the two poles of this conductor.

$$\therefore \text{Potential difference} = \frac{\text{Work (joule)}}{\text{Amount of electricity (Coulomb)}} = (\quad) \text{ in volts}$$

Example :

- If the work done to transfer an electric charge of 300 coulombs between two points is 33300 Joules, calculate the potential difference between the two points .

$$\text{The potential difference} = \frac{\text{work done}}{\text{amount of electricity}} = \frac{33300}{300} = 111 \text{ volts}$$

How to measure the potential difference? What is it's measuring unit?

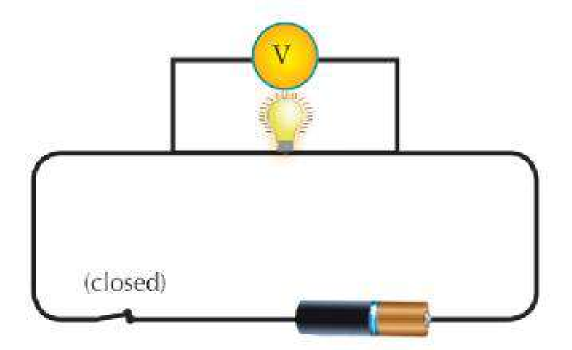
The Voltmeter (Fig.7) is used to measure the potential difference between two poles of a conductor.
Its symbol is -(V)- when drawing electric circuits . The measuring unit of the potential difference is Known as the Volt . Volt is the potential difference between the two poles of a conductor on doing a work of 1 joule to transfer a quantity of electriciy (1 Coulomb).

▲ Figure (7) : Voltmeter

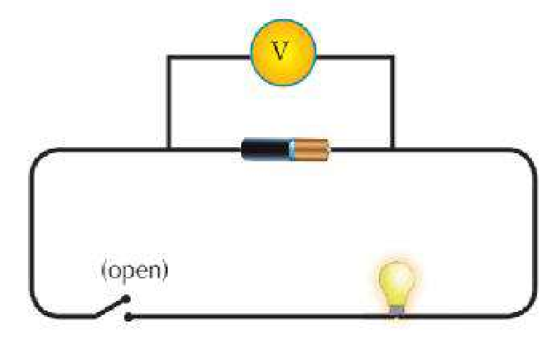
How is the Voltmeter connected in a circuit?

It is connected in parallel.

- The Voltmeter is also used to measure the potential difference between the two poles of a battery, which is known as the electromotive force (e.m.f) which can be defined as the potential difference between the two poles of the battery when the electric circuit is open Hence,no electric current passes through. E.m.f is measured in Volt.



▲ Figure (8) : Measuring the potential difference between the 2 ends of an electric lamp



▲ Figure (9) : Measuring the potential difference of a battery or (e.m.f)

③ The electric resistance (R) :

- During the flowing of an electric current through conductors (the wires), it faces an obstruction. The electric resistance can be defined as: the opposition that the electric current faces during it's passage through a conductor.
- How to measure the electric resistance? What are it's measuring unit?
- An instrument known as the Ohmmeter is used to measure the electric resistance. The electric resistance measuring unit is known as the Ohm.

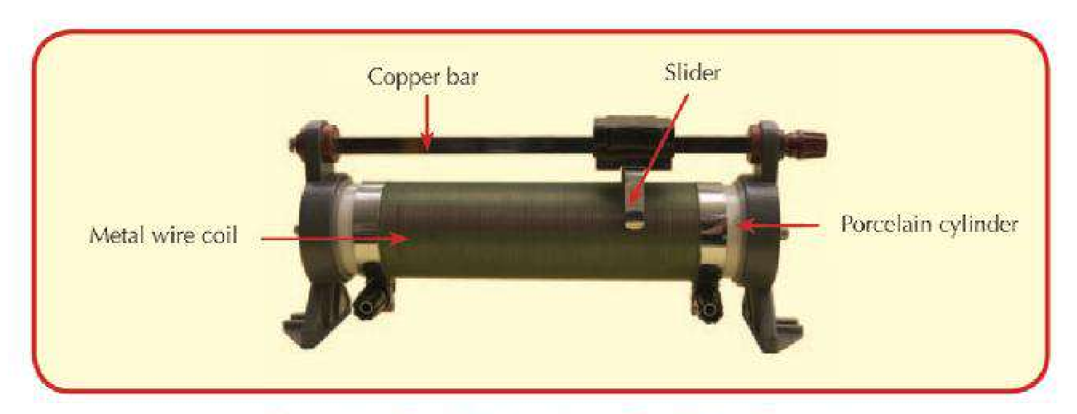
The Ohm is the resistance between two points of a conductor when a constant potential difference of 1 volt, applied to these points, produces a current of 1 ampere in the conductor .

Types of electric resistance :

1. Constant, (it's symbol in an electric current is
2. Variable (Figure 10), it's symbol in an electric current is

The variable resistance (The Sliding Rheostat):

It is a resistance that you can change it´s value in order to adjust the value of the current intensity and potential difference in the different parts of the circuit.



▲ Figure (10) : The variable resistance (The Sliding Rheostats)

Components of the variable resistance :

1. Metal wire of high resistance, coiled around a cylinder made of an insulating substance as porcelain.
2. Thin copper sheet is touching the wire and can slide over it for the whole length of the cylidner and known as the slider.

Variable resistance idea of work:

Through the sliding of the flexible sheet on the wire coil, you can control the resistance that the current faces on passing through wire, and that is by controlling the length of the wire that enters the circuit where the current passes and thus controls the current in the circuit. Hence, if the length the wire increases, the resistance increases and the current intensity decreases.

Information

Enriching information

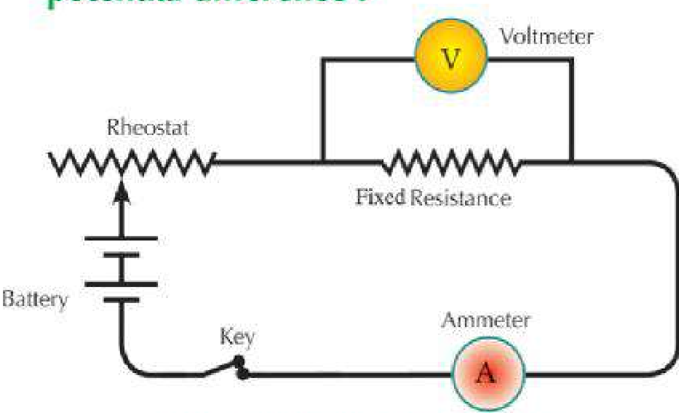
- Inside the fuel tank of a car, there is a buoy connected to a changeable resistance that controls the flow of the electric current in the car's fuel scale. When the level of the fuel is low, an electric current flows in a circuit causing the deviation of fuel pointer indicating that the car needs to the fuel.

The relationship between the current intenisty and the potential difference (Ohm's law):

Is there a relationship between the intensity of a current passing through an electric conductor, and the potential difference between its poles? To answer this question conduct the following experiment:



Discover the relation between current intensity and potential difference :



▲ Figure (11) : verification of ohm's law

1. Connect an electric circuit (Figure11) consisting of a battery, variable resistance (rheostat), ammeter (connected in series), voltmeter (connected in parallel with a fixed resistance), and a key, and all are connected in series.
2. Switch On electric current to the circuit through an On/Off key and observe the current intensity in the circuit (reading of the ammeter in amperes) (I), and the potential difference between two ends of fixed resistance (reading of the voltmeter in volts) (V).
3. Change the resistance value by using the Rheostat; therefore, the values of (I) and (V) will change. Record their values?.
4. Repeat the above steps several times by changing the resistance each time. Find the values of (I) and (V) each time.
5. Find the result of dividing $\frac{V}{I}$ in each time.
6. Record your results in the following table:

Current intenisty (I) in Amperes	Potential difference (V) in Volts	$(\frac{V}{I})$

What do you observe about the results you have obtained?

- Dividing $\frac{V}{I}$ = constant value.
- This constant value equals the conductor's resistance and its symbol is (R) and its unit is (Ohm).
- Therefore, V/I = R and this relationship is known as Ohm's law.
- i.e. the potential difference between the two ends of a conductor is directly proportional to the intensity of the current passing through this conductor when the resistance is constant.

▲ Figure (12) : A triangle that illustrates the relationship between the potential difference and current intensity

Ohm: It is the resistance of a conductor which allows the passing of an electric current its intensity is one ampere and the potential difference between its two terminals is one volt.

Ampere: It is the current intensity passing through a conductor whose resistance is one ohm and the potential difference between its poles is one volt.

Volt: It is the potential difference between the two poles of a conductor whose resistance is one ohm and the intensity of the current passing through it is one ampere.

Ohm's Law:

The electric current intensity passing through a conductor is directly proportional with the potential difference between its ends when the temperature is constant.

V= constant × I

In other words:

$$V = R \times I$$

as (R) is the constant

Therefore, resistance = Potential difference (V)/current intensity (I)

From this relationship, resistance can be defined as the ratio between the potential difference of the two ends of a conductor and the current intensity passing through it.

Example: If an electric current of 0.2 amperes passes through an electric heater and the potential difference between its two ends is 220 Volts , calculate the heater's resistance .

Solution: Resistance = Potential difference (V)/current intensity (I) = 220/0.2= 1100 Ohm

History

Scientists with a history

- George Simon Ohm is a german scientist who discovered the quantitative properties of electric currents. He discovered a law in electricity that was named after him. The measurement unit of the electric resistance was also named after him.

For extra activities and practice, go to MOE website.



Lesson 2



Electric Current and Cells



Lesson objectives

By the end of this lesson, you will be able to :

- ✓ Identify some sources of the electric current.
- ✓ Compare between the alternating- current and the direct-current.
- ✓ Compare between the methods of connecting the cells in electric circuits.
- ✓ Appreciate the importance of using batteries in facilitating more important applications in our life.



Lesson terms

- Direct current.
- Alternating current.
- Connecting electric cells in series.
- Connecting electric cells in parallel.

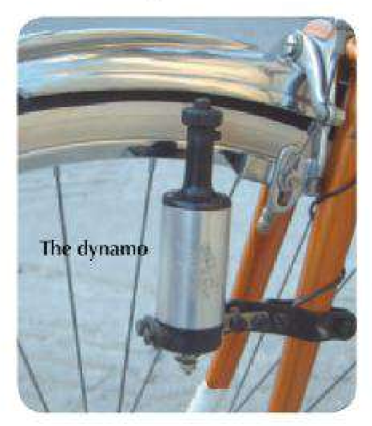
Electricity plays an important role in our everyday life.

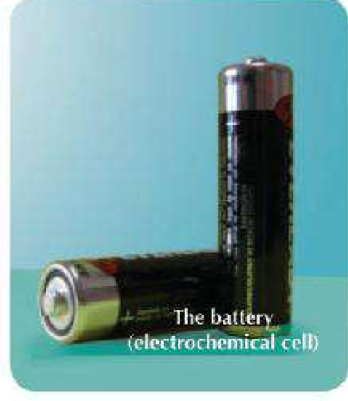
In the previous lesson you knew what electric current means. Do you know some of its sources and types?

Some sources of the electric current:

There are two ways to generate the electric current:

1. Converting the chemical energy to electric energy in electrochemical cells (batteries or dry cells) the electric current produced in known as the " direct current " .
2. Converting the mechanical energy to electric energy by using the electric generator (dynamo). The electric current produced is called the "alter - nating current " .





▲ Figure (13) : Some sources of the electrical energy

Types of the electric current

There are two types of electric current:

1 The direct electric current:

- It's an electric current with constant intensity. It flows in one direction through the electric circuit, since the electrons flow from one pole of the electro chemical cell passing through all the components of the circuit , to the other pole .
- This current is produced from electrochemical cells as the dry cell .
- The direct current can only be transported for short distances.
- It is used in electroplating and in operating of some electric appliances.
- It cannot be converted into an alternating current.

2 The alternating electric current:

- It's an electric current with variable intensity and direction . It flows in two opposite directions,where the electrons flow in one direction at the beginning, then starts to flow in the opposite direction . This cycle is repeated many times with high speed .
- This current is produced from the electric generators as the dynamo.
- The alternating current can be transported to short and long distances.
- It is used in lightening houses, streets and operating electric appliances.
- It can be converted to direct current.



▲ Figure (14) : Graphic representation of the electric current types

Now you can compare between the direct current and the alternating current using the following table:

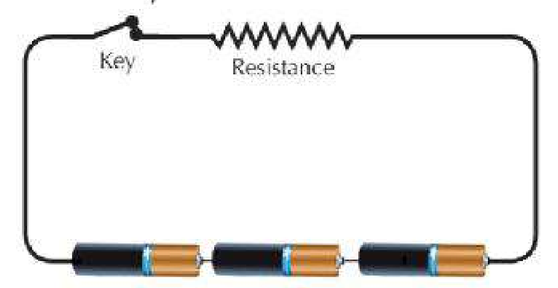
Aspects of comparison	Direct current	Alternating current
Direction	....	....
Intensity	....	....
Source	....	....
Transport	....	....
Uses	....	....
Conversion to one another	....	....

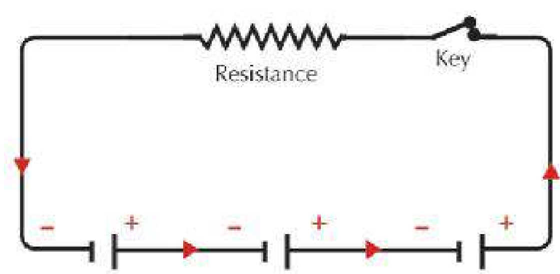
Methods of connecting the electric cells in a circuit

To obtain batteries, the electric cells are connected in different ways, such as:

1 Connection in series:

- It is done by connecting the negative pole of the first cell to the positive pole of the second cell with a copper wire, then connecting the negative pole of the second cell to the positive pole of the third cell and so on. The positive pole of the first cell and the negative pole of the last cell are considered the two poles of the electric battery.



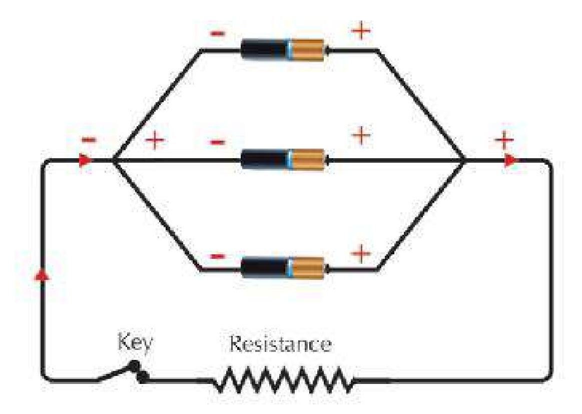


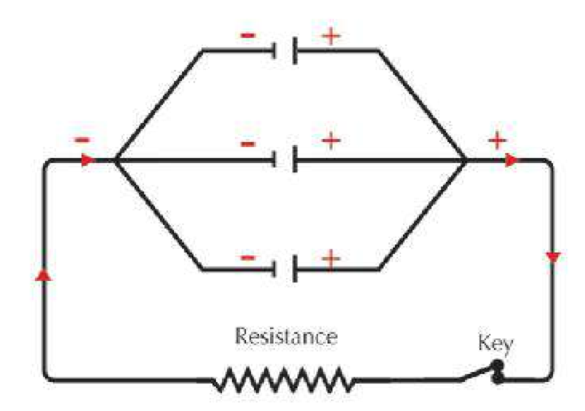
▲ Figure (15) : Connection of electric cells

- Electric cell is represented in the drawing by(-| |+) and they are two straight parallel lines . The longer line represents, the positive pole and the shorter one represents the negative pole.

2 Connection in parallel:

- It is done by connecting the positive poles of all electric cells together, and connecting the negative poles of all cells together with copper wires. Therefore, there'll be one positive pole and one negative of the battery that are the two poles of battery.

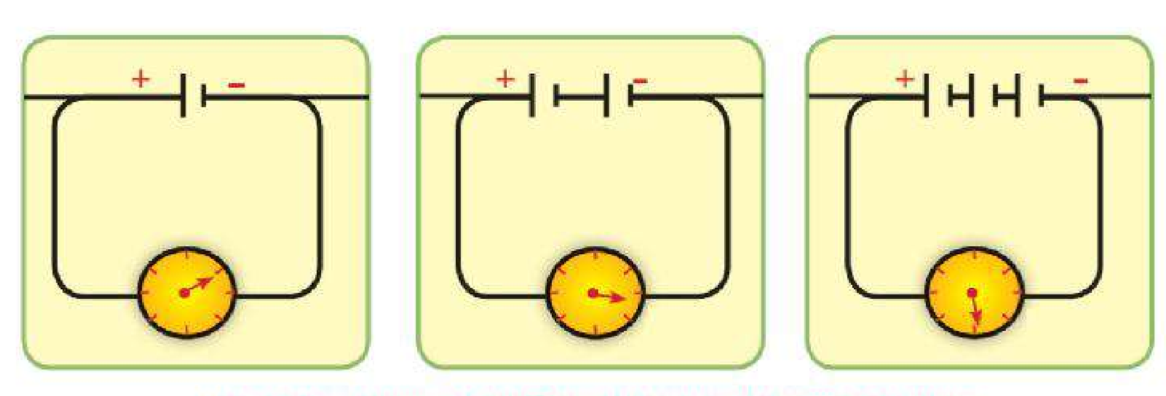




▲ Figure (16) : Connection of electric cells



Measuring the electromotive force (e.m.f) of cells connected in series :



▲ Figure (17) : Measuring the e.m.f of several electric cells connected in series.

1. Make an electric circuit consisting of one cell and a voltmeter. Determine e.m.f reading in the voltmeter (E_1).
2. Connect another electric cell similar to the first cell in series. Determine e.m.f reading (E_2).
3. Connect another similar cell in series with the other two cells . Let us assign the e.m.f reading in this case be (E_3).

What do you observe about the three values of e.m.f ?
What's your conslusion?

1. The e.m.f in the second case is twice the emf in the first cast, i.e. (E_2) is twice the value of (E_1).
2. The e.m.f in the third case is three times the emf in the first case, i.e. (E_3) equals three times the value of (E_1).

Conclusion:

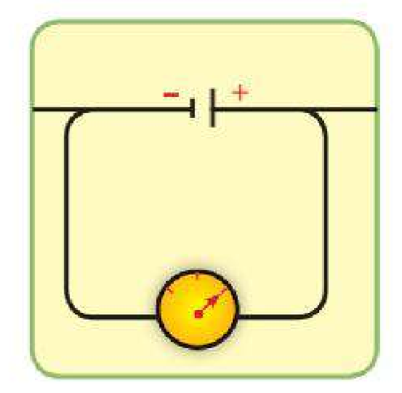
- e.m.f of a battery made up of cells connected in series = the sum of e.m.fs of these cells i.e. $E = E_1 + E_2 + E_3$
- e.m.f of a battery madeup of similar cells connected in series :
  e.m.f of the battery = e.m.f of one cell x n
  where "n" is the number of similar cells .

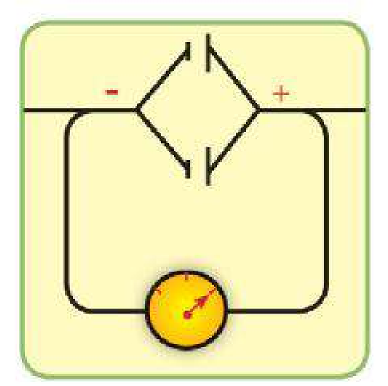


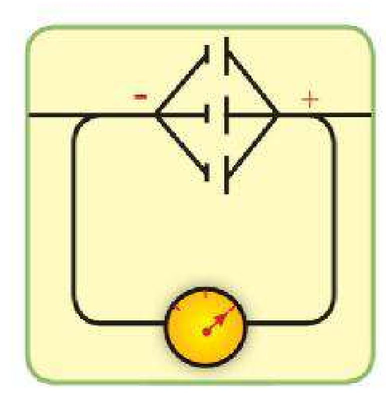
Activity

Measuring e.m.f of electrodes connected in parallel :

- Repeat the previous experiment but connect the cells in parallel and let e.m.f reading in each step be (E_1), (E_2), and (E_3).







▲ Figure (18) : Measuring the e.m.f of several electric cells connected in series.

What do you observe about the three values of e.m.f ? What's your conclusion?

Observation:

- The reading in the third case is the same as in the second case and the same in the first case, i.e $E_1 = E_2 = E_3$.

Conclusion:

- The e.m.f of several similar cells connected in parallel equals the e.m.f of one electric cell.
- i.e. e.m.f of the battery = e.m.f of one cell.

Example :

A battery consists of three electric cells, the e.m.f of cell each cell is 3 volts, calculate the electromotive force when the cells are connected : (1) in series (2) in parallel

Solution :

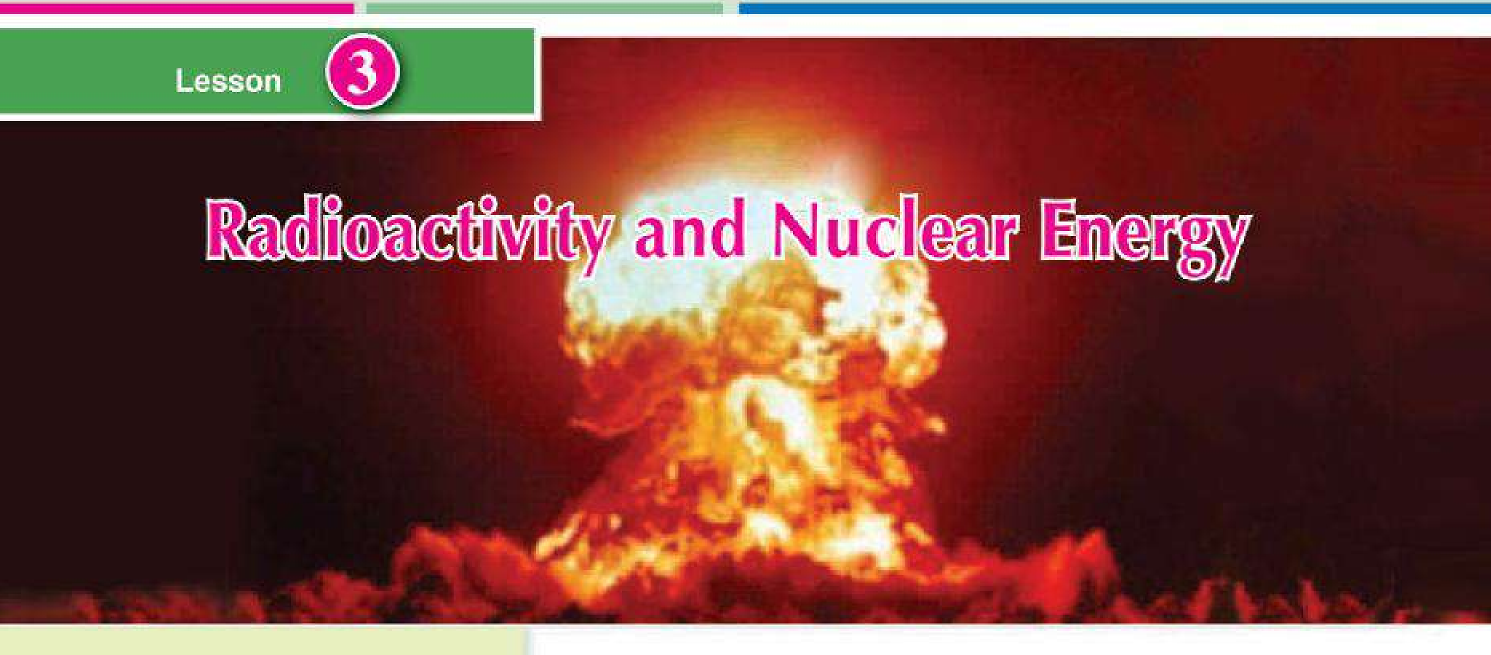
1. Cells connected in series: e.m.f (battery) = e.m.f (one cell) X n (number of cells) = 3 X 3 = 9 volts.
2. Cells connected in parallel: e.m.f battery = e.m.f one cell = 3 volts

For extra activities and practice, go to MOE website.



Lesson 3

Radioactivity and Nuclear Energy

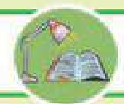




Lesson objectives

By the end of this lesson, you will be able to :

- ✓ Identify the phenomenonof radioactivity.
- ✓ List examples of radioactive elements.
- ✓ Identify the peaceful usages of the nuclear energy.
- ✓ Identify the harmful effects of radioactive pollution and means of prevention.
- ✓ Give an openion about the importance of nuclear energy use in the peaceful aspects of human.



Lesson terms

- Radioactivity.
- Nuclear Energy.

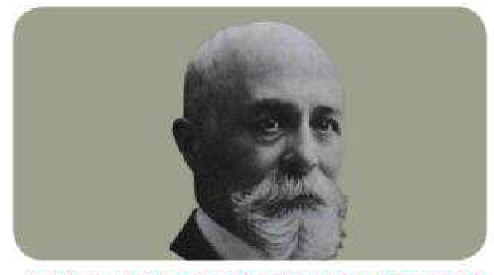
You previously knew that the elements consist of atoms and the atom's mass is concentrated in the nucleus . Also, you knew that the composition of the atom is responsible for the chemical and physical properties of the element.

The atom's nucleus is considered as energy store. This energy originates due to a force that binding the nucleus components and overcoming the repulsion force between the positively charged protons that found inside the nucleus.

These forces are the source that gives the atom its tremendous force which is known as the (nuclear energy).

Discovering the radioactivity phenomenon:

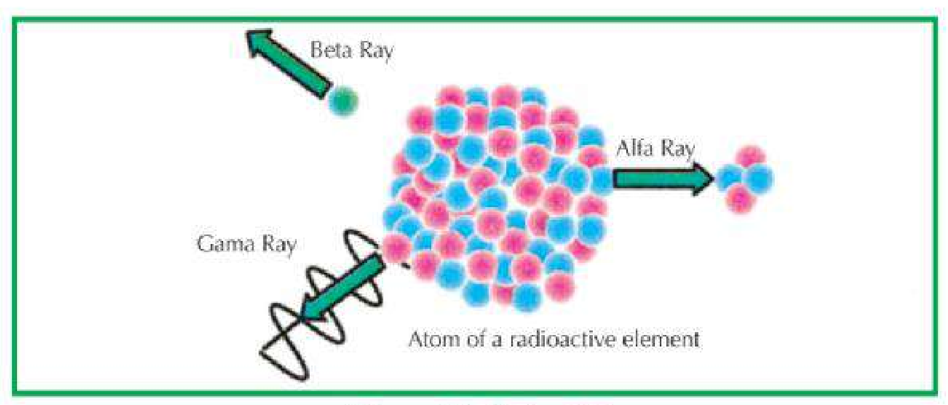
The radioactivity was known for the first time by the French scientist "Henry Becquerel" who discovered the emission of an unseen rays from the uranium element that has the capacity to penetrate through solid objects.



▲ Figure (19) : The scientist Henry Becquerel

What is meant by the radioactivity phenomenon?

The radioactivity phenomenon is defined as the spontaneous decaying of the atom's nuclei of some radioactive elements that are present in nature in an attempt to achieve a more stable composition, where the atom nuclei of these elements contain a number of neutrons more than the number required for its stability. Therefore, it is unstable due to its excess energy. These elements are known as natural radioactive elements. Some of the examples of these radioactive elements are radium, uranium, cesium polonium , rubidium, selenium and zirconium .



▲ Figure (20) : Radioactivity

Types of Radioactivity:

Natural radioactivity :

It is the radiation produced from the radioactive elements present in nature.

Artificial radioactivity :

It is the radiation or nuclear energy that is either released during nuclear reactions that can be controlled and which are done in nuclear reactors (peaceful uses) or that can not be controlled in the case of nuclear bombs (military uses).



Scientists with a history

- Dr. Aly Mostafa Moshrafa is an Egyptian scientist who was described by Einstein that he is one of the greatest physicists in the world. He has great theories in the fields of atom and radiation. Basics of manufacturing the atomic bomb were based on his theories. He gave his objection to this matter and called for the necessity of exploiting the atom and radiation for the benefit of humanity. Use EKB to search for the achievements of arabian and forgen scientists in the nuclear energy



Dr. Aly Mostafa Moshrafa

The peaceful uses of nuclear energy

The scientists were interested in finding beneficial uses of the nuclear energy. And that was by controlling the amount of energy released from the nuclear reactions conducted in nuclear reactors, therefore, can be used in peaceful uses in a lot of fields as:

1. **In the medical field:** To treat and diagnose diseases like cancer.
2. **In the agricultural field:** To eliminate pests and to improve of some plant races.
3. **In the industrial field:** To convert sand to silicon sheets which is used in manufacturing computer processors and programmed electric circuits that are used in electric appliances and also used to discover the defects in manufactured products.
4. **In the electricity generation field:** The temperature produced from the nuclear energy is used to heat water till boiling . The water steam produced is used to operate the turbines to generate electricity.
5. **In the space exploration field:** It is used as a nuclear fuel used by rockets that fly in space.
6. **In the drilling field:** Used in the search and the drilling for petroleum and underground water.



In disease diagnosis field

In the space exploration field



In industry

▲ Figure (21) : Some uses of nuclear energy

Risks and harmful effects of radioactive pollution and means of protection:

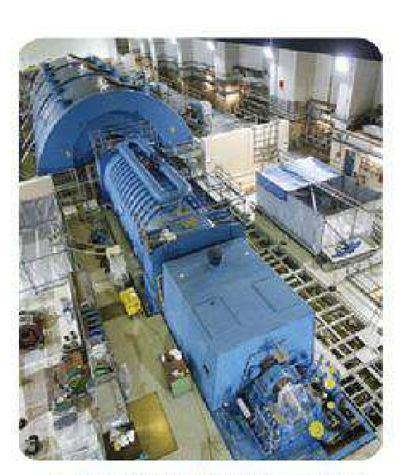
There are two sources of radioactive pollution:

1 Natural sources:

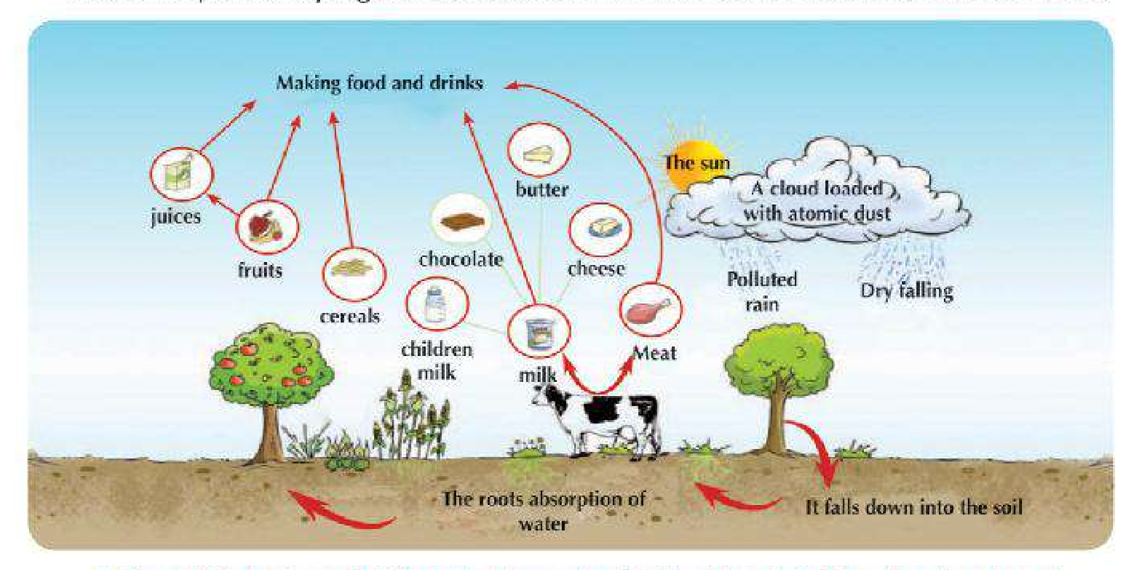
- They are represented by the natural radiation sources found on the surface of earth and in the cosmic radiation that comes from outer space.

2 Artificial sources:

- They take place as a result of the explosion of nuclear bombs that some countries experiment every once in a while . They are also due to nuclear reactors. All this leads to raising the amount of radiation and its varieties in the environment surrounding , which leads to radioactive pollution of the environment .
- The Chernobyl accident resulted in the pollution of food products by radioactive elements. On the 26 of April 1986, an explosion occurred in the Russian reactor as a result of an error in operation. This resulted in the melting of the reactors core which lead to a nuclear explosion and consequently the release of many of the radioactive elements forming an atomic cloud that was carried by the wind to most of the countries in eastern and western Europe. The peak of the pollution was when rain fell in May of the same year carrying the radioactive elements with it to the surface of earth.



▲ Figure (22) : Inside a nuclear reactor



▲ Figure (23) : An image that illustrates the way by which food is polluted by radioactive elements

In the previous figure, We notice that pollution from the clouds loaded with the atomic dust reaches earth either by dry falling or by falling with rain to earth. Therefore, the plants and soil are polluted by the fallen radioactive isotopes and thus herbivores as cows and sheep. Thus their milk products and meat will all be polluted by radiation.

What are the radioactive isotopes (isotopes are atoms that contain the same number of protons and different number of neutrons) which are found in polluted food?

It has been known that the elements that are found in the polluted food after the Chernobyl accident are iodine and cesium isotopes. They are elements produced from the decay of the nuclear fuel (uranium – 235) when absorbing the neutrons and carried by the clouds and wind as an atomic radioactive dust.

The radiation effects on the human body

The radiation effects on the human body differs with the duration of the exposure to the radiation. This effects can be divided in two groups:

1 The effects of exposure to a large dosage of radiation for a short time:

- This will lead to the damage of each of the bone marrow, spleen, the digestive system and the central nervous system.The bone marrow is resposibale for forming the blood cells is affected by radiation. This will reduce the number of red blood cells which causes the feeling of being sick, having a sore throat accompanied by nausea, vertigo and diarrhea.

2 The effects of exposure to small doses of radiation for a long period of time:

- If a person is exposed to small doses of radiation for a long time (months or years), the most important effects are:

a - Physical and genetic effects :

The changes that appear on a living organism as a result of exposure to radiation are called physical changes.

b - Genetic effects :

The radiation could result in genetic changes as it causes changes in the sex chromosomes composition which results in abnormal births.

c - Cellular effects :

Radiation causes changes in the cells composition. The chemical composition of the hemoglobin changes and it becomes incapable of carrying oxygen. Thus, exposure to large doses of radiation destroys the cells.



▲ Figure (24) : Exposing to radiation causes genetic changes

Ways of Protection from Radiation



▲ Figure (25) : Wearing gloves and protective clothes to protect against radiation

1. Those who work with radioactive elements in laboratories and hospitals should wear protective gloves and clothes from radiation.
2. Setting special laws to oblige the nuclear reactors to cool the hot water down before pouring it into seas and lakes.
3. The nuclear wastes are get rid of by different methods depending on the strength of the radiations they emit:
   (a) The nuclear wastes that emit weak or intermediate radiation intensity are buried underground after being surrounded by a layer of cement or rocks.
   (b) The nuclear wastes that emit strong radiation are deeply buriedunderground.
4. The following conditions should be considered on burying the radioactive wastes:
   (a) These radioactive wastes should be buried remotely away from streams of underground water to avoid their pollution.
   (b) The region chosen to store radioactive wastes should be stable and not exposed to earthquakes or volcanoes.



▲ Figure (26) : Some wastes are placed deeply inside the earth after surrounding it with a layer of cement or rocks

The safe dose when exposed to nuclear radiation:

In general, we should not be exposed tonuclear radiation. The limit of the safe dose of radiation for those people who work in radiation field should not exceed 20 milli-Sievert per year. However,the safe dose of radiation for public should not exceed 1milli-Sievert per year.

The Sievert (sv) is the international unit of measuring the radiation absorbed by the human body. (1 milli-Sievert = 10^{-3}Sievert).

The effective safe dose of radiation differs according to:

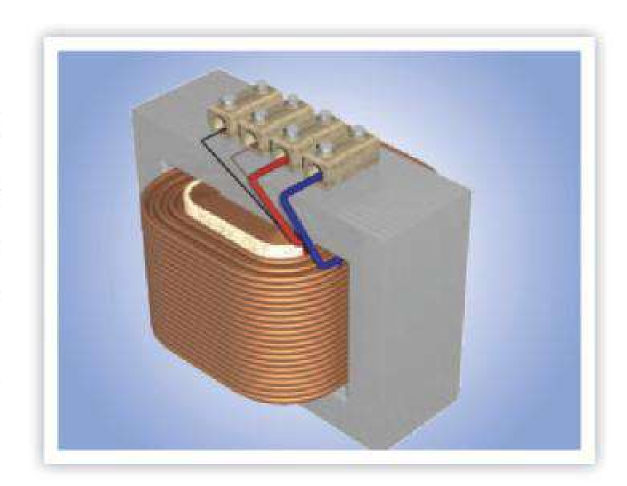
1- The person's age.
2- The interval of being exposed to radiation.
3- The body tissue exposed to radiation.

For extra activities and practice, go to MOE website.



Technological application

The electric potential at home and in electric equipments:



Electric transformer

- You may know that the electric voltage at home is 220 Volt. But, what if you get a device operated by voltage of 110 Volt? Of course you know that if you connect the device directly at home, it will break down. You should use a device known as "The electric transformer" by which you get the required voltage (110 Volt out of 220 Volt (a step down transformer that reduces voltage). Search for the types of the electric transformers using the school library and the internet. Write a report to be attached to your portfolio.

- The nuclear explosion in bombs and atomic reactors leads to radioactive pollution causes a dangerous harms of the environment for handreds of years.
 make a research on radioactive pollution ,its causes the way of protection then show what you gained with your classmates and teacher.



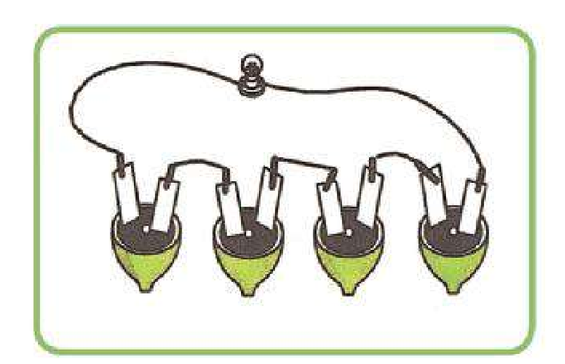
Science, Technology and Society

Enriching activity

Make a lemon battery (in series and in parallel):

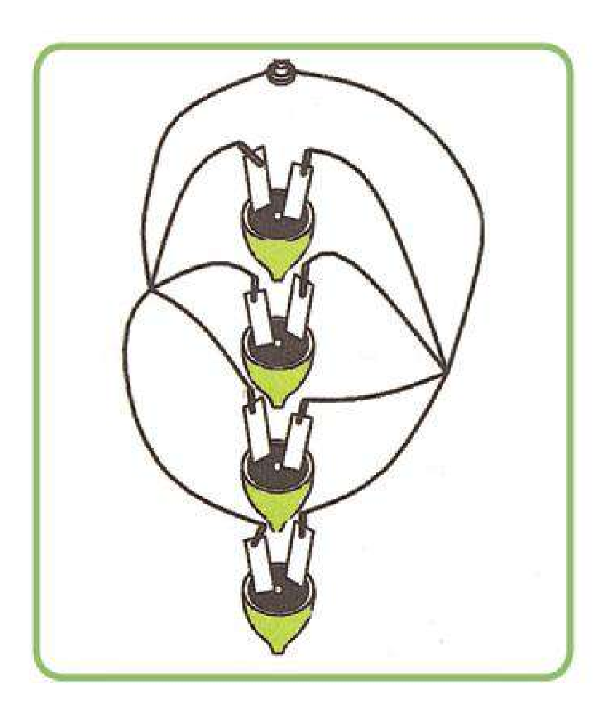
Tools and materials used:

Fresh ripe lemons – small ribbons of copper – 4 small ribbons of lead – copper wires for connection – paper clips – two small electric lamps.



Procedures:

1. Cut the lemons into halves.
2. Fix ribbons of both copper and lead and fix the wires as in the figure .
3. Connect the free ends of ribbons together and with a small electric lamp .



Record your observations.

....

....

Analyze your conclusions:

- Which battery has it's cells connected in series? Which battery has its cells connected in parallel?
- Which battery caused the lighting of the lamp with greater intensity?
- How can you improve the lighting of the lamp connected to the battery that caused the lamp to light with less intensity?

The Second Term - Unit Three

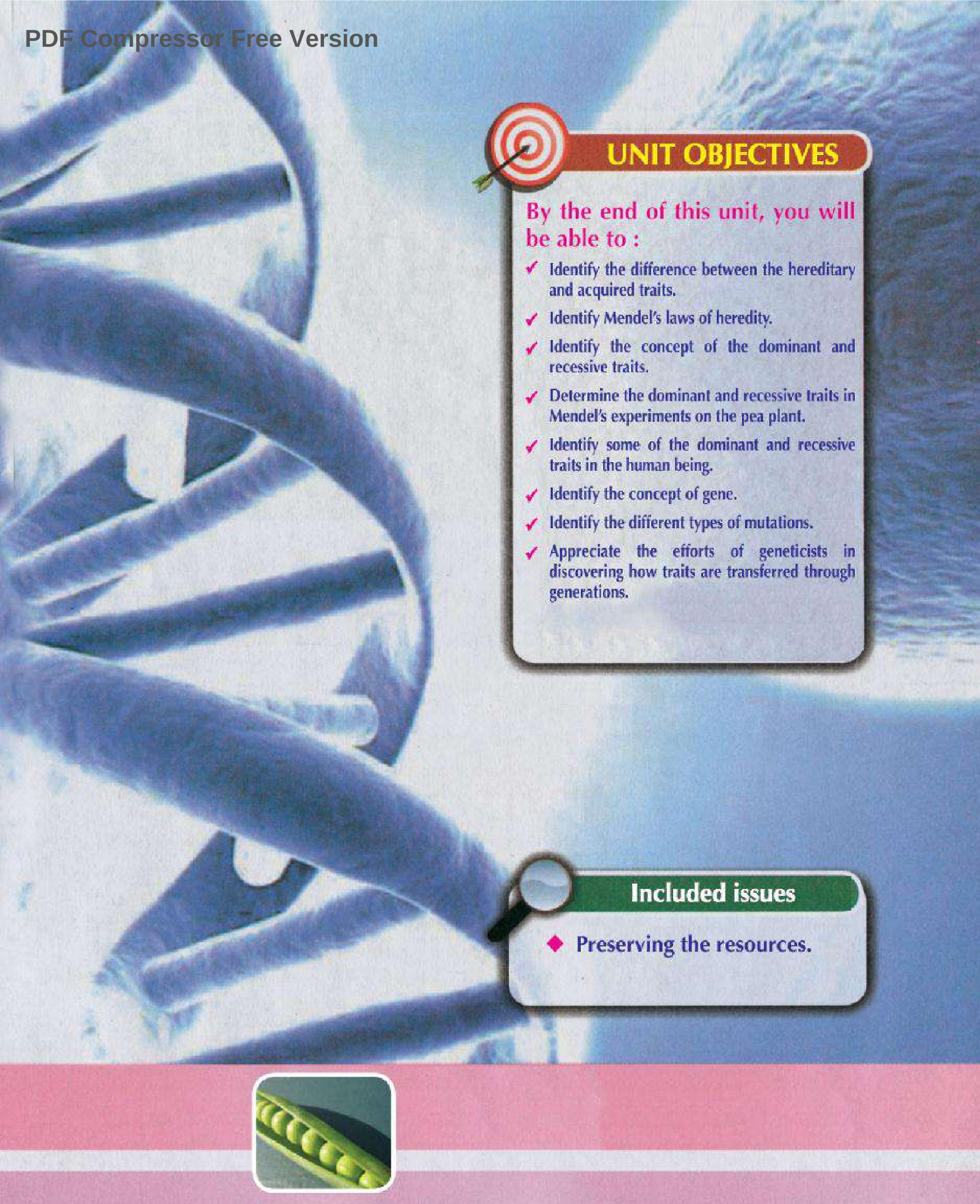
Genetics

Introduction

Genetics explains to us the existence of the similarity between you and your brothers or sisters as well as the differences in some external traits.

This is because genetic traits transfer from a generation to another according to basics and laws that geneticists reached.

Genetic traits transfer through the reproduction. In the asexual reproduction, the offspring are exactly similar because they are produced from one parental cell. In the sexual reproduction, there are similarities and differences between offspring as they are resulted from the mating of two individuals.



UNIT OBJECTIVES

By the end of this unit, you will be able to :

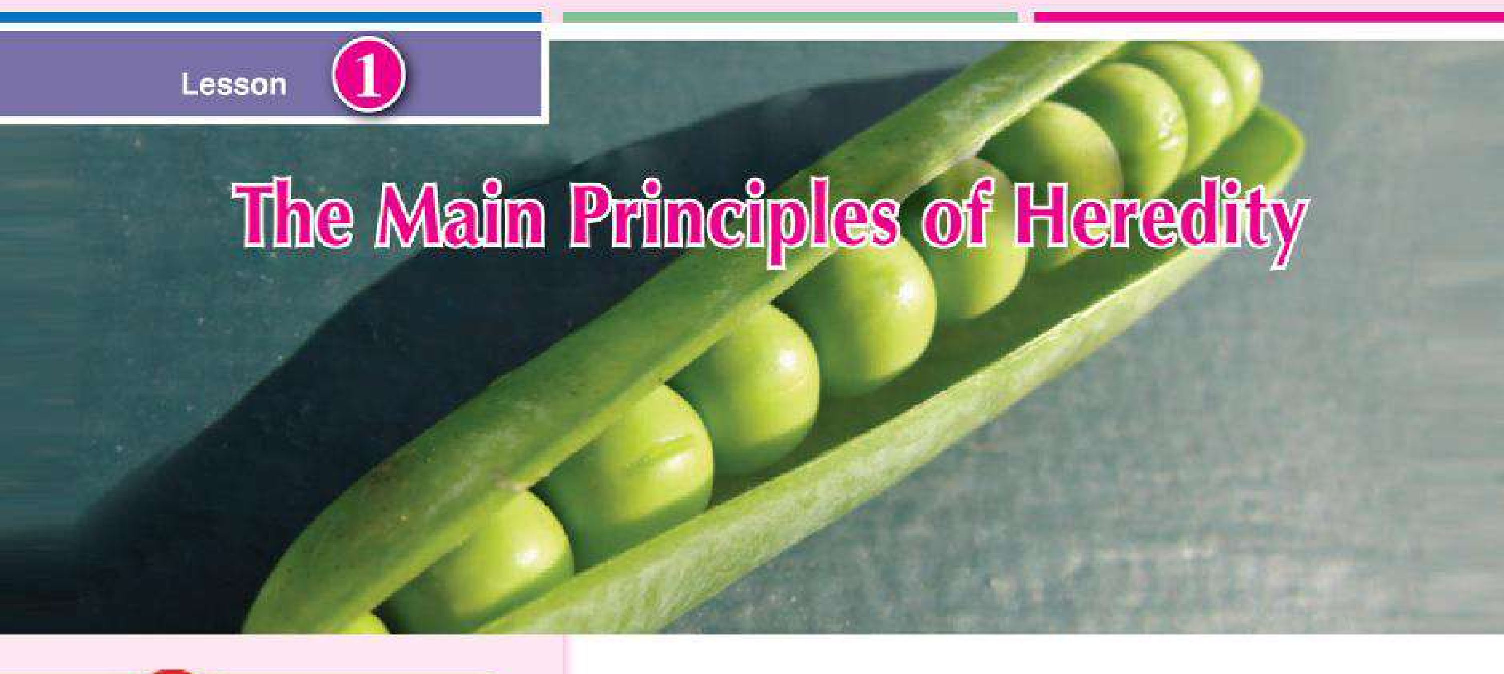
- ✔ Identify the difference between the hereditary and acquired traits.
- ✔ Identify Mendel's laws of heredity.
- ✔ Identify the concept of the dominant and recessive traits.
- ✔ Determine the dominant and recessive traits in Mendel's experiments on the pea plant.
- ✔ Identify some of the dominant and recessive traits in the human being.
- ✔ Identify the concept of gene.
- ✔ Identify the different types of mutations.
- ✔ Appreciate the efforts of geneticists in discovering how traits are transferred through generations.

Included issues

- ◆ Preserving the resources.

Lesson 1
The main principles of heredity

Lesson 1



The Main Principles of Heredity



Lesson objectives

By the end of this lesson, you will be able to :

- Determine the difference between the hereditary and acquired traits.
- Explain why Mendel chose the pea plant for his experiments.
- Identify Mendel's two laws of heredity.
- Identify the concept of the dominant and recessive traits.
- Determine the dominant and recessive traits in Mendel's experiment of the pea plant.
- Determine some of the dominant and recessive traits in the human being.
- Identify the concept of the gene.
- Identify the role of the genes in determining the traits of the living organisms.
- Appreciate the scientists role in dicovering the nucleic acids structure and their role in genetics.



Lesson terms

- Hereditary traits
- Acquired traits.
- Dominant traits.
- Recessive traits.
- The gene

Thousands of years ago, Man has observed that some traits are transmitted from one generation to another and scientists have called them "hereditary traits" like the color of the hair, the color of the skin, the numbers of fingers and the blood groups. Some traits are not transmitted from one generation to another and they are called the "acquired traits".

Now, you might wonder:

How hereditary traits are transmitted from one generation to another and why some traits of the parents appear in the offspring?

The experiments by Mendel placed the basics for the scientific studies of heredity. According to the results reached by Mendel and over the years, heredity scientists have gathered a lot of information on the reasons why the living beings have the forms they have, or behave the way they do. How did Mendel start his experiments and what are the results that he reached?



▲ Figure (1) : The scientist Mendel (The founder of heredity)

Experiments of Mendel

Mendel choose the pea plant to conduct his research and his choice of this plant was due to the following reasons: :

1. It is easy to plant the pea plant and it grows fast.
2. The life cycle of the pea plant is short.
3. The flowers of the pea plants are hermaphrodite, and thus it can self pollinate.
4. It can easily be artificially pollinated (human intervention).
5. Pea plant produces large numbers of offspring in a generaion.
6. There are several types of peas that have pairs of contrasting traits that can be recognized easily. Some of the plants are long stemed and others are short stemed. The flowers of some of the plants are white and others are red. The pods of the peas could be green in color or yellow and so on.




▲ Figure (2) : The pea plant

Despite the numerous different traits of the pea plant, Mendel chose seven main traits to conduct his experiments and the following figure shows these traits:

Seed Shape	Seed Color	Pod Shape	Pod Color	Flower Color	Flower Position	Stem Height
Smooth	Yellow	Swollen	Green	Red	Side	Tall
Wrinkled	green	Sinuous	yellow	white	end	Short

Mendel studied the inheritance of each pair of the contrasting traits seperated by following specific scientific steps. To explain that, we follow these steps in studying the seed color trait of the plant:

Mendel's experiment to study the seed color of the pea plant:

1. Mendel planted a pea plant that produces yellow seeds and a pea plant that produces green seeds for several generations to make sure of the purity of these traits. Thus, the yellow seeds produced yellow seeds plants generation after another, and the same goes for the green seeds plants. Mendel was able to do that by self pollination of these plants for several generations.

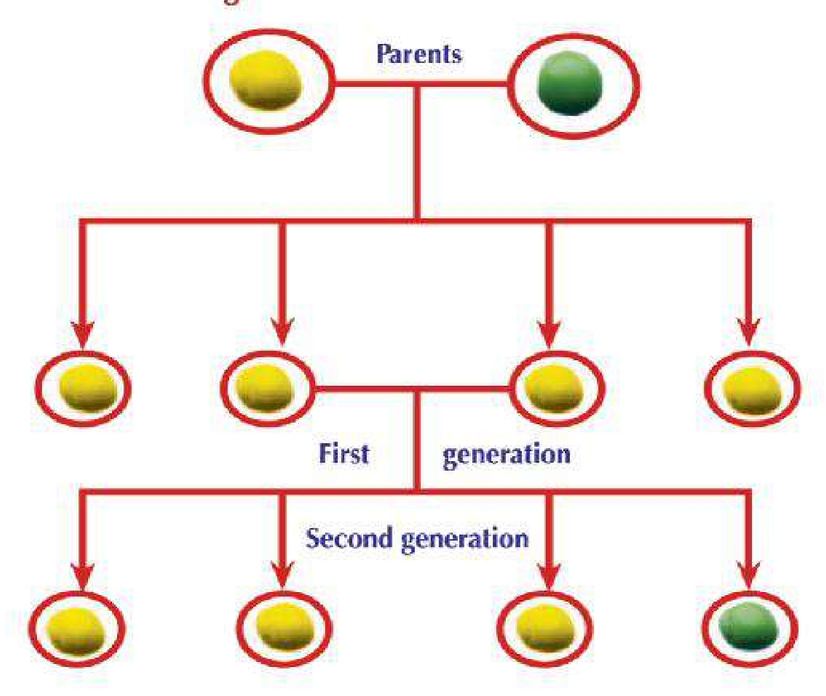
2. After making sure of the purity of the yellow and green seeds traits of the plants, he planted the seeds of these plants (parents) . When plants were produced carrying flowers, Mendel removed the stamens of their flowers before the another becomes mature to avoide a self pollination.

   Why did Mendel remove the stamens from the flowers of the plants?

   ....

3. By means of cross pollination, Mendel pollinated the flower of the plants that produces yellow seeds with pollen grains from a plant that produces green seeds.He also pollinated the flower of the plants that produces green seeds with pollen grains from a plant that produces yellow seeds , then he covered the stigmas of the pistils to avoide cross pollination.

   Why did he covers the stigmas ?



Mendel observed that all the plants produced only yellow seeds and the green color of the seeds disappeared completely in the plants of first generation. Mendel named the trait of yellow color of the seeds the "dominant trait" that is it dominates the other trait. He named the trait of the green color of the seeds the "recessive trait"

4. Mendel let the first generation plants self pollinate, then planted the resulting seeds swollen and got the second generation plants, some with green seeds representing only a quarter of the produced plants , but the plants with yellow seeds represent three quarters of the second generation.

The principle of complete dominance

Mendel repeated the same experiment for the seven other traits of the pea plant and got the same results. He found out that the long-stem trait dominates the short - stem trait, the red color of the flower dominates the white color, the side position of the flower trait dominates the end position, the smooth seed trait dominates the wrinkled one, the swollen pod shape trait dominates the sinuous , and the green pod color trait dominates that of the yellow color. He observed that one of each pair of traits disappears completely in the first generation then the two contrasting traits appear in the second generation in a ratio of approximately 3:1.



▲ Figure (4)

Mendel named the trait that appears in all individuals of the first generation as "the dominant trait" and named the other trait that disappears in the individuals of the first generation as "the recessive trait".

The principle of complete dominance : is the oppearance of a dominant hereditary trait in the individuals of the first generation when two individuals are crossed over, one of them carries a pure trait contrasting the trait carried by the other individual.



Figure (5)

What did Mendel deduce from the previous experiment?
Mendel deduced the following :

1. The color of the seed depends on (factors) present in the plants transmitted from one generation to another by means of gametes. There is a factor that determines the yellow color of the seed and another factor that determines the green color of the seed.
2. When these factors meet in the first generation, the yellow color factor is dominant over the green color factor that is recessive and this leads to the production of only yellow seeds in the first generation.
3. When the gametes in the first generation are produced by meiosis, these factors separate (segregate) from each other, then they meet again on the production of the second generation.

4. If the yellow color factor meets with the green color factor another time, the result is a yellow seed, but if the green color factor meets with another green colour factor the result is a green seed.

Mendel's first law: The law of segregation of factors :

Mendel made several assumptions to explain the appearance of the dominant trait and the disappearance of the recessive trait in the first generation in the experiments of the pea plant that he studied, and these assumptions are:

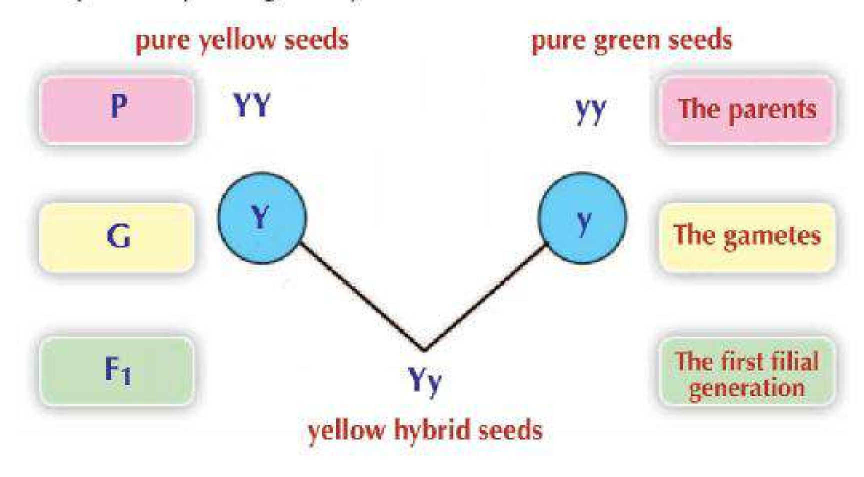
- The hereditary traits are transmitted from the parents to the offspring by means of hereditary factors which are now known as the genes.
- In a living organism, every hereditary trait is controlled by two hereditary factors (one from the father and the other from the mother). These factors are similar or homozygous if the trait is pure and not similar (different) if the trait is impure or heterozygous and the living organism that carries an impure trait is called a hybrid.
- The two hereditary factors in every trait separate when the gametes are formed, where each gamete carries one factor for each hereditary trait.

Mendel has summarized the previous assumptions in a law known as Mendel's first law or the law of segregation as he named it, and it states:

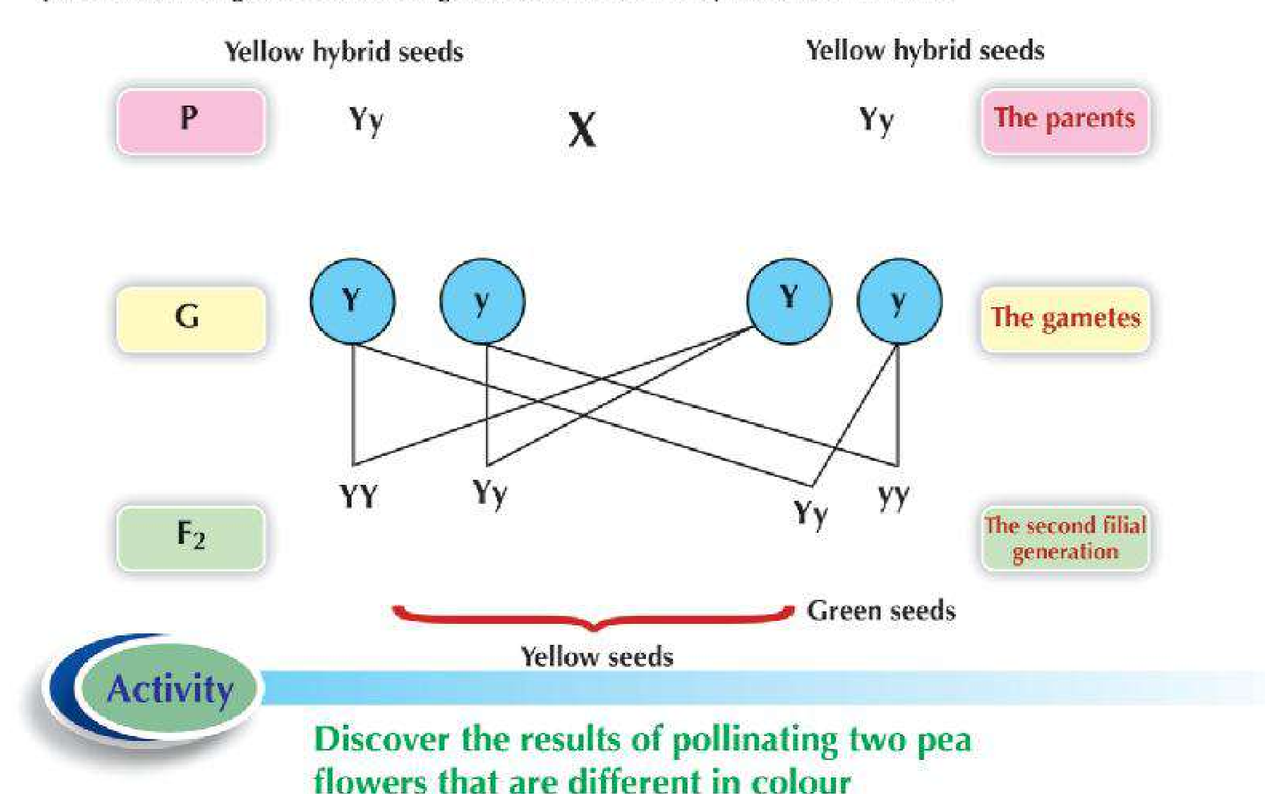
> **"When two members of any pair of Homozygous hereditary traits are different from each other, only the dominant trait appears in the F1 generation, while the two traits appear in the F2 in the ratio of 3 dominant : 1 recessive."**

Using symbols to represent the results of the experiment:

If we choose a symbol to represent the color of the seeds in the plant and we symbol the dominant color (yellow) by the letter (Y) and we symbol the recessive color (green) by the symbol (y), therefore the pea plant with pure yellow seeds becomes (YY) and the pea plant with pure green seed becomes yy and we can represent the crossing-over between the two plants by using the symbols as follows:



When the experiment continues and we let the plants of the first generation self pollinate, we get the second generation that we symbol as follows:



Activity

Discover the results of pollinating two pea flowers that are different in colour

The following figure represents the results of crossing-over between two different color flowers of the pea plant. By referring to what you have learned, answer the following questions:

The contrasting traits are ....

The dominant trait is ....

The recessive trait is ....

Explain your answers

....

If the flowers resulting from the first generation are self pollinated, express by drawing and symbols the results of the second generation.

X

F_1

The scientist Mendel is the founder of heredity. Use EKB to look for videos, pictures, and ppt about the work of Mendel.then show what you gained with your classmates and teacher.

Mendel's second law: The law of independent assortment of hereditary factors.

Mendel continued his experiments on the pea plant by studying how two pairs of contrasting traits are inherited. He conducted a mixed pollination between two pea plant where one carries two pure dominant traits (tall stem and red flowers) and the other carries two recessive traits (short stems and white flowers).

Mendel observed that all the first generation plants had tall stems and red flowers and when he left the first generation plants to self pollinate to produce the second generation individuals he got the following plants:



▲ Figure (6)

9	3	3	1
Tall stem, red flowers	Tall stem, white flowers	Short stem, red flowers	Short stem, white flowers

From the previous results, observe the following:

- In the first generation all the plants had tall stems and red flowers, thus the two dominant traits appeared.
- In the second generation the ratio of the number of red flower plants (dominant) to white flowers (recessive) was 12 : 4 thus 3 : 1, and the ratio of the number of tall stem plants (dominant) to short stem plants (recessive) was 12 : 4 thus 3 : 1.

And from this Mendel deduced his second law (independent assortment of the hereditary factors) which states :

> **"When two Homozygous individuals bearing two or more pairs of alleles are crossed each pair of traits is assorted at random and is inherited independently of the other and will appear in the F2 generation in the ratio 3:1"**

Information

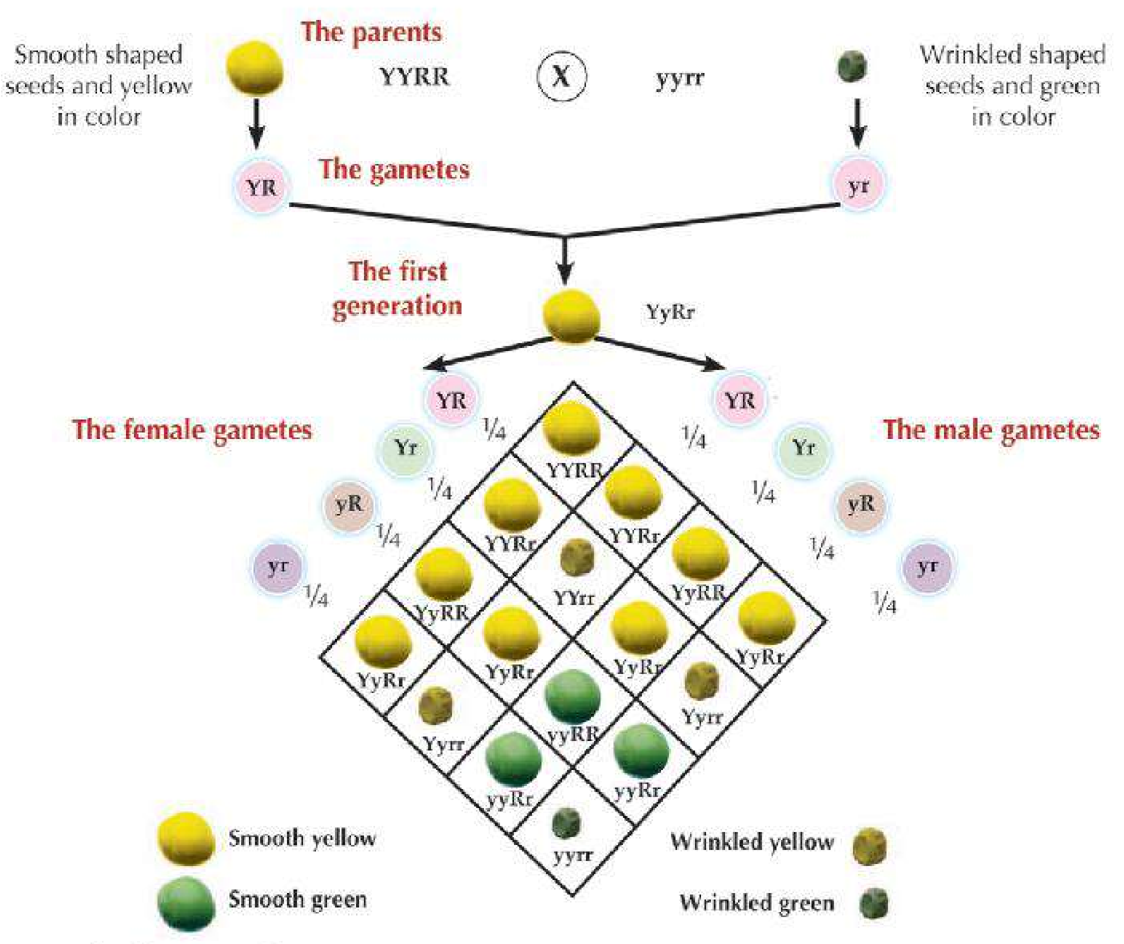
Enriching information:

- At the beginning of the present century, many experiments were conducted to apply Mendel's laws of heredity on a number of traits in the animals and the plants. The results showed that inheriting some traits followed Mendel's laws, but there were cases that did not completely follow Mendel's laws, and it was agreed to name them the non-Mendelian heredity.



Discover the inheritance of two pairs of the contrasting traits

The following figure shows the results of the mixed pollination between two pea plants where one carries two dominant pure trait, the smooth seeds and yellow colored seeds, and the other carryies two recessive traits, the wrinkled seeds and green colored seeds.



Observe the figure and answer

- What are the traits that appeared in offspring of the first generation?
- Are they dominant or recessive traits?
- How many types of gametes produced in individuals of the first generation?
- Describe the second generation plants.
- What is the ratio of the green seeds to the yellow ones in the second generation?
- What is the ratio of the smooth seeds to the wrinkled ones in the second generation?

For extra activities and practice, go to MOE website.

The dominant and recessive traits in the human being

Many human hereditary traits follow the Mendelian heredity where the trait is controlled by one pair of genes. It can be dominant or recessive. The individuals who receive at least one dominant gene from either parent will have the dominant trait, and those who receive a recessive gene from both parents will have the recessive trait . Observe the following figures to identify some of the traits that follow the complete dominance principal in the human being:







▲ Figure (7): The ability to roll the tongue is one of the dominant traits in the human being



▲ Figure (8): The free ear lobe trait dominates the attached ear lobe trait.



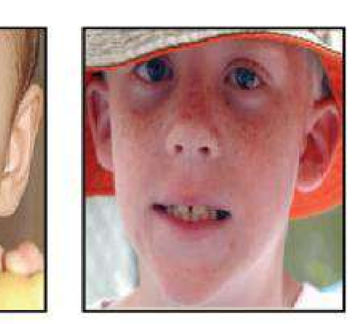
▲ Figure (9: The curly hair trait dominates the straight hair trait



▲ Figure (10): The wide eyes trait dominates the narrow eyes trait



▲ Figure (11): The presence of cheeck dimples trait dominates the no dimples trait

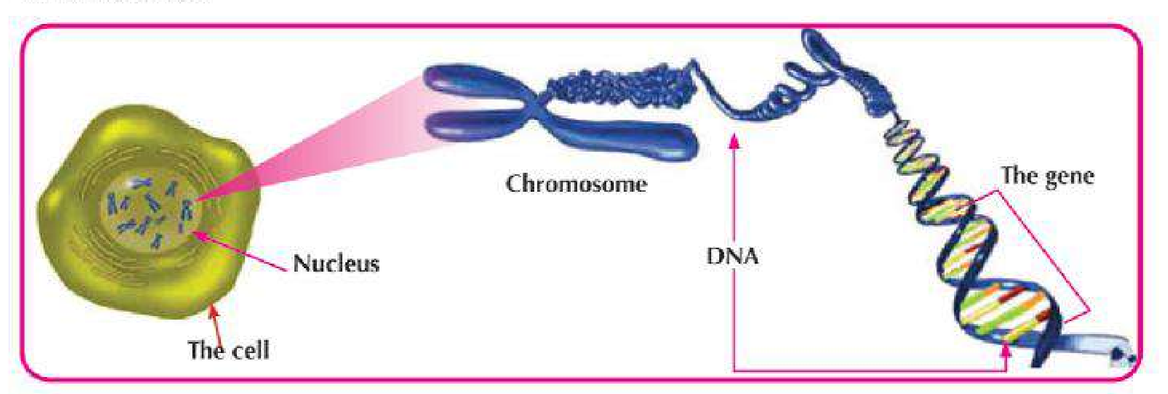


▲ Figure (12): The absence of freckles in the face trait is the dominant trait and the presence of freckles is the recessive trait

The genes

What are the genes?

You know that the chromosome is chemically consisted of a nucleic acid called DNA bind with the protein. The nucleic acid is what carries the hereditary traits of the living organism. Scientists have found that the genes are DNA parts present on the chromosomes.



▲ Figure (14) The hereditary material inside the nucleus of the cell.



Egyptian Knowledge Bank
بنك المعرفة المصري

Watson and Crick have constructed a model of DNA consist of two strands coiled around each other forming a double helix shape.

The Gene is considerd a part of DNA which cosists of smaller structural units called Nucleotides.

Search by using (EKB) for the efforts of Watson and Crick in exploring the structure of DNA and the importance of this in the develoment of genetics. the demonestrate what you get to your classmates and your teacher.

Information

Enriching information

- The Danish scientist Johansen used the term gene instead of the hereditary factor and introduced the term the "genotype" for the gene structure in the living organism, and the term "phenotype" for the hereditary trait that appear on the living organism.

How do the genes perform their functions?

The genes control the body growth, features and functions.
The scientists Badel and Tatum discovered the means of how the gene controls the appearane of a trait, where they found that every gene gives a special enzyme. This enzyme is responsible for the occurrence of a reaction resulting in a protein showing a specific hereditary trait. The two scientists received for that a Nobel Prize in the year 1985.

Let us take an example for the inheriting the trait of eyes colour, If you inherit one gene from one of your parents and it is responsible for the brown color of eyes trait which is the dominant trait, then the gene works on forming a protein where this trait appears on you.




▲ Figure (16): The brown eyes trait is dominant over the colored eyes




▲ Figure (17): The Black hair is dominant over the light colour hair.



Science, Technology and Society

Technological application:

The bio-technology collaborating with the traditional ways to combat malnutrition:

Around 500,000 people every year are affected by losing their sight, and this is due to the deficiency in vitamin (A). It is one of the important elements of nutrition that its deficiency leads to malnutrition. Deficiency in vitamin (A) is widespread in those who depend on eating rice. The rice does not contain pro-vitamin (A) or what is knownn as carotene (a substance which is converted into vitamin A in the body). Solving this problem is done by producing rice that contains pro-vitamin (A), and it depends on changing the genetic structure of the rice crop. This is done by inserting the genes that result in the creation of the pro-vitamin (A) compound inside the tissue that stores the starch in the plant seeds.

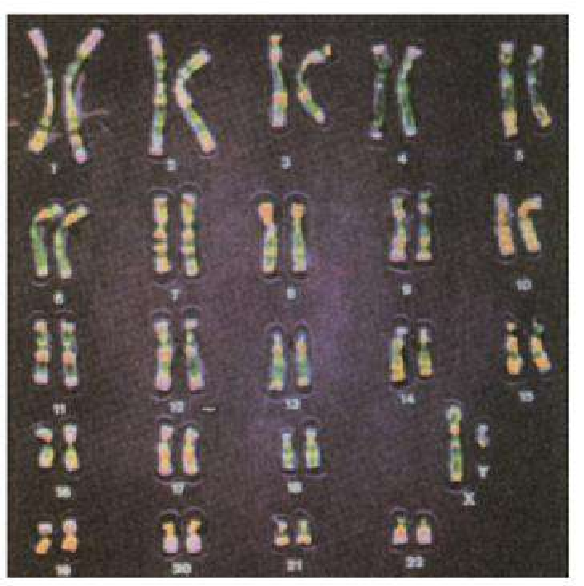
For extra activities and practice, go to MOE website.

Life application

The human genome project

This project started in October 1990 with the aim of discovering all of the human inheriting factors (the genes). The project also aims to discover and determine the complete sequence of all the 3 billion pair of nitrogenous bases. The scientists have called the twenty first century the hereditary century due to the importance of this discovery.

The scientists decided to work hard to obtain a detailed very precise map for the sequence of the nitrogenous bases, and predicted that drawing this map will help to a great extent to understand the human biology and identify the single differences in the genome between one person and another. They discovered that although more than 99% of the DNA is similar in humans, the single difference could affect to a great extent the acceptance of the individual to the harmful environmental effects like bacteria, viruses, poisons, chemicals, medicines and various treatments.



The human chromosomes

Scientists believe that drawing a map will help them to identify the genes responsible for the various diseases like cancer, diabetes, vascular diseases, mental diseases, and to identify the various hereditary functions to the human. The project also is interested in the effect of the various mutations on the function of the genes.

The Second Term - Unit Four

Hormones

Introduction

The human body contains a group of organs known as endocrine glands that excrete chemical substances known as hormons that collaborate in their functions to achieve the homeostasis in human body.

UNIT OBJECTIVES

By the end of this unit, you should be able to :

- ✓ Identify the concept of the hormone.
- ✓ Mention some hormones and their function in human body.
- ✓ Identify the role of hormones in homeostasis in human body.
- ✓ Identify some diseases results from hormone disorder in human body.

Included issues

- Preventive health.
- Homeostasis.
- Hormone disorder.



Lesson 1
Hormones in the human body



Lesson 1

Hormones in the Human Body



Lesson objectives

By the end of this lesson, you will be able to :

- ✓ Identify the concept of hormone.
- ✓ Mention some hormones and their function in human body.
- ✓ Identify the role of hormones in homesstaisis in human body.
- ✓ Identify some diseases results from hormone disorder in human body.



Lesson terms

- Hormones
- Endocrine glandes.

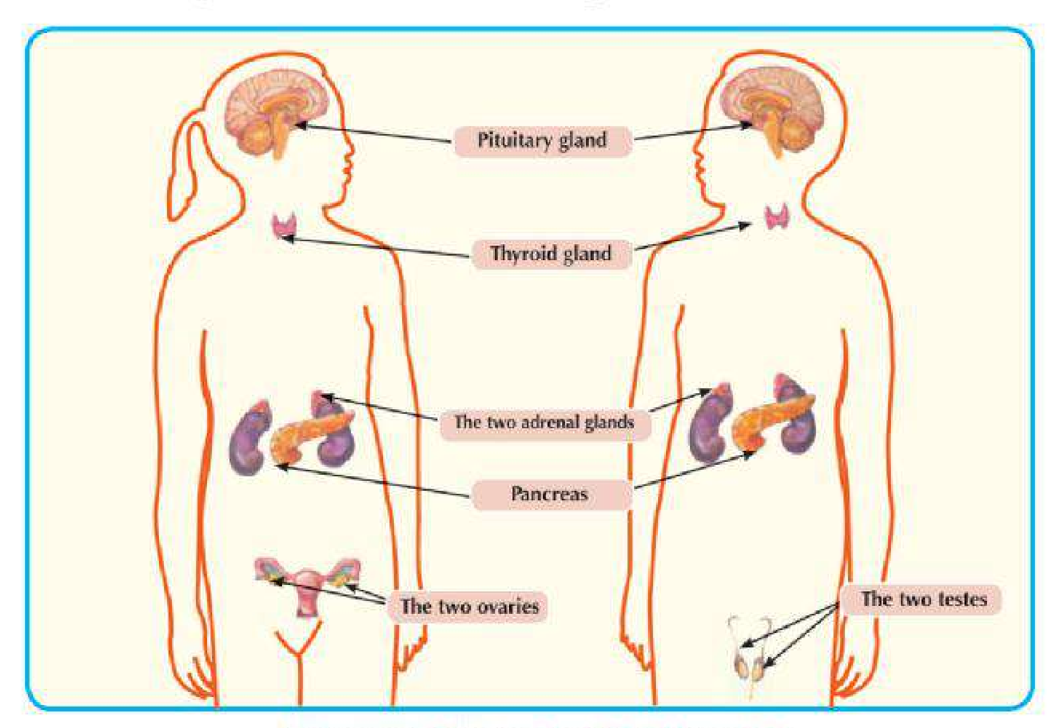
As you have learned, the function of the nervous system is to organize and coordinate both the activities and functions of the organs of living organisms. However, scientists' experiments and researches proved that there is another form of organizing and coordinating these activities and functions. This form is performed by chemical substances secreted by special cells in the body. These secretions, known as hormones, work in collaboration with the nervous system to do this task.

The concept of the hormone

The hormone is a chemical substance (or a chemical message) that controls and organizes most of the vital activities and functions in the bodies of living organisms.

- Hormones are secreted in the body by some organs called endocrine glands or ductless glands (figure 20) as they secrete their hormones directly in the blood stream without passing in ducts. These glands secrete more than 50 hormones in the human body.
- Cells that the hormone affects are almost located away form the endocrine gland that secretes them. So, blood is the only way for the hormone to reach its site of action or what is known as the target cells .

The most important endocrine glands in the human body



▲ Figure (20): Endocrine glands in the human body

(1) Pituitary gland:

Below the brain, there is a small gland in the size of a pea seed which is called the pituitary gland. In spite of its small size, it is called the "master gland" or the "main gland" because it secretes hormones that regulate the activities of most of the other endocrine glands. It consists of two lobes; each one secretes various types of hormones.

Among these hormones secreted by the pituitary, there is what is known as "growth hormone" that controls the speed rate of the growth of your muscles, bones and other organs of your body. This hormone determines the height that you will reach when you become a grown up person.

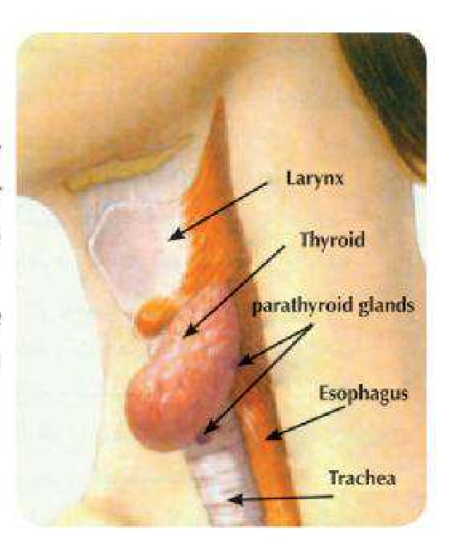
In addition to growth hormone, the pituitary secretes a group of hormones. Some of these hormones activate the thyroid and the two adrenal glands. Others activate the sexual glands (the two testes and the two ovaries) when the person is about to reach adulthood and others activate the mammary glands to secrete milk,and another harmone which facilitate the process of delivery ,and another harmone which regulates the amount of water in the body

Science technology &society

- Why do the vocal cords of females make voices louder than those of vocal cords produced by males? This occurs because the sex hormones in the mature male body cause an increase in the thickness of the vocal cords. So, the thin vocal cords in a female's larynx vibrate faster than the thick vocal cords in a male's larynx.

(2) Thyroid gland :

It consists of two lobes located in the front side of the neck on both sides of the trachea and linked together by a small part. Thyroid secretes a hormone called or thyroxin that plays a main role in the food assimilation processes in the body. It librates the necessary energy of the human body from food. Thyroid also secretes the hormone "calcitonin"that controls the level of calcium in the blood. Figure (21)

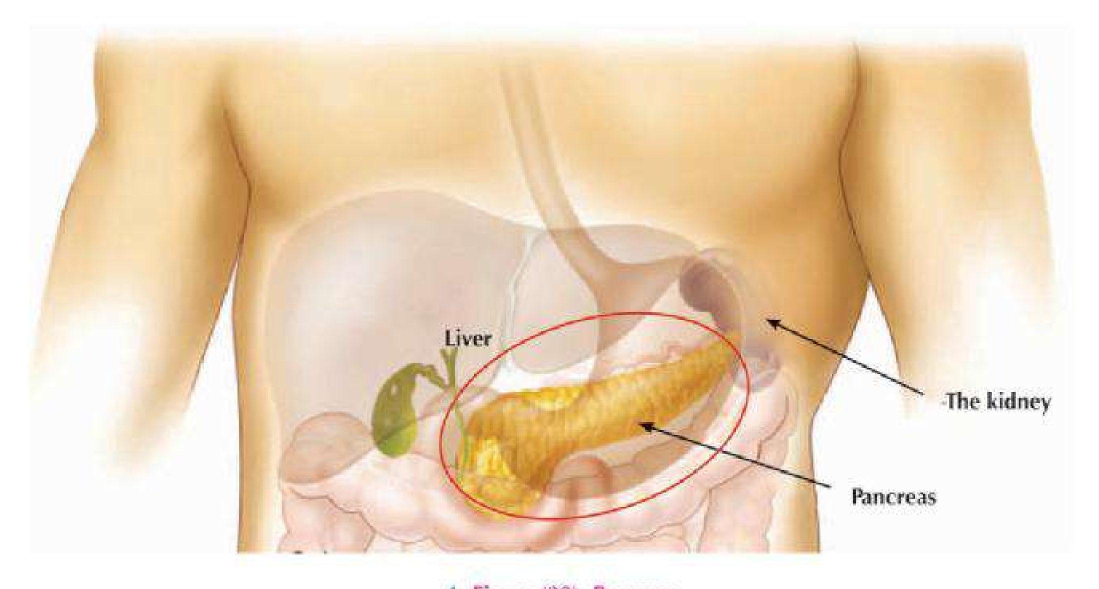


▲ Figure (21): Thyroid and parathyroid glands

(3) Pancreas :

You previously studied the role of pancreas in the digestion process. Determine the position of the pancreas in figure (22). In addition to the role of pancreas in the digestion process, it is considered an endocrine gland as well. It secretes a hormone called "insulin". This hormone helps the sugar transporting from blood to the body's cells as it can be used to release energy. So, this hormone reduces the level of sugar in the blood.

Also, pancreas secretes a hormone called "glucagon" whose function contradicts the function of the insulin hormone. It raises the level of sugar in the blood through stimulation the liver to convert the stored glycogen into glucose that release into the blood stream to be available to the body's cells.



▲ Figure (22): Pancreas

Some hormones of endocrine glands and their functions

Gland	Hormones	Function
Pituitary	Growth hormone	Regulate the growth of the body as a whole
	Thyrod stimalating hormone	Stimulate thyroid to secrete its hormones
	The activating hormone of sexual glands	Affects the development of sex organs prior to adulthood
Thyroid	Thyroxin	Librates the energy necessary for the body from food
	Calcitonin	Controls the calcium levels in the blood
adrenal glands	Adrenalin	Stimulates body's organs to respond to emergencies
Pancreas	Insulin	Stimulates the storage of glucose sugar in liver.
	Glucagon	Stimulates the release of glucose sugar from the liver
The two ovaries	Estrogen	Appears female secondary sex characteristics
	Progesterone	Promotes the growth of endometrium
The two testes	Testosterone	Appears the male secondary sex characteristics

Some diseases resulted from the hormone disorder in human body

There is a state of an accurate balance among the endocrine glands. However, one of these glands does not sometimes work properly. Consequently, the balance of these glands gets disturbed and Man has a state of a hormone disorder in his body. The result is one of the hormone disorders as shown in the following table:



▲ Figure (25): The goiter disease resulting form the enlargement of thyroid



▲ Figure (26): Measuring the concentration of sugar blood (glucose) for persons suffer from diabetes.

Some diseases resulted from the hormone disorder in the human body

Disease	Description	Reason
Dwarfism	The body stops growing so the person becomes a dwarf.	Decrease of secretion in the growth hormone at the childhood.
Gigantism	A continuous growth in the limbs' bones so the person becomes a giant.	Increase of secretion in the growth hormone at the childhood.
Simple goiter	Enlargement of thyroid gland and the neck.	Decrease of secretion in the thyroxin hormone due to the lack of iodine in food as it enters in the hormone's structure.
Exophthalmic goiter	Enlargement of thyroid gland accompanied by loss of weight, tension and exophthalmoses.	Increase of secretion in the thyroxin hormone with large amounts.
Diabetes	Feeling very thirsty and multiple urination times.	Due to the decrease in the secretion of the insulin hormone, the cell's are unable to use glucose.

For extra activities and practice, go to MOE website.



Science technology & society

- In the past, scientists did not know why some persons do not grow to the normal size and stay as dwarfs. Then, it was discovered that pituitary gland in the bodies of those dwarfs secretes extremely small amounts of the growth hormone. Through this discovery, scientists treated some of these cases by injecting the human growth hormone extracted from newly dead corpses in the children's bodies whose pituitary gland do not produce enough amount of the growth hormone. The amounts of the growth hormone that they could get were extremely small and not enough in addition to the possibility of containing some microbes that may cause infection by various diseases.
- In 1979, scientists succeeded in manufacturing sufficient amounts of the human growth hormone by genetic engineering technology. They managed to insert a human gene (that carries instructions for the formotion of a human growth hormone) into DNA nucleic acid of the bacterial cells. In this way, they were able to produce and collect large amounts of the human growth hormone by great numbers of bacteria (in which this gene was inserted). Then, this hormone was refined and experiments and researches conducted on it proved its validity for the human use in 1985. This hormone succeeded in treating children of limited growth.

References

في ضوء التوجه العلمى والتربوى الذي ارتكز عليه إعداد هذا الكتاب، فإنه يمكن الاستعانة بهذه المراجع:

- Dispezio, M. ; et al. (2008). Science Insight - Exploring Living Things. Scott Forsman - Addison Wesley.
- Dispezio, M. ; et al. (2008). Science Insight - Exploring Matter and Energy. Scott Forsman - Addison Wesley.
- Exline, J. D. (2008). Science Explorer - Earth's Changing Surface. Prentice Hall.
- New Star Science, Ginn.
- Heinemann Explore Science, Heinemann.
- Advanced Level Physics . Nelkon & Parker.
- College Physics By R. Serawy & J. Foughn, 2nd Ed. Saunders College Publishing.
- Fundamentals of Physics
  D.Halliday, R. Resnick, J. Walker
  Publisher :J. Wiley, 1993 .

- موسوعة الشباب فى المعلومات، د. عبد الباسط الجمل.
- الكتاب الكبير عن الفضاء والمكان، وليم أدهورز.
- الموسوعة العلمية الشاملة - مكتبة لبنان ناشرون - بيروت.
- أنشطة إبداعية في العلوم للمرحلة الابتدائية، المركز القومى للبحوث التربوية بالتعاون مع هيئة التعاون الدولية اليابانية (الجايكا).
- كتاب المعرفة فى جسم الإنسان، موسوعة سؤال وجواب فى جسم الإنسان، مهرجان القراءة للجميع، مكتبة الأسرة.
- كتاب الصوت والضوء، سلسلة القراءة للجميع، مكتبة الأسرة.
- أساسيات الفيزياء / تأليف : ن . بوش.
- الكهربية والمغناطيسية / تأليف : د . منصور محمد حسب النبي.
- موسوعة العلماء والمخترعين / إعداد : د . إبراهيم بدران - د . محمد فارس.
- الفيزيقا للصف الثاني الثانوي / تأليف : أ . د . محمد عبد المقصود النادي - أ . د . نايل بركات محمد الجهاز المركزي للكتب الجامعية والمدرسية - مصر .



المواصفات الفنيــة:

رقــم الكتـــاب:	٢٠/٣/٣٣/١٥/٧/١١١٥
مقــاس الكتـــاب:	$\frac{١}{٨}$ (٥٧ × ٨٢) سم
طبـــع المتـــن:	٤ ألوان
طبـــع الغـــلاف:	٤ ألوان
ورق المتـــــن:	٨٠ جم أبيض
ورق الغـــــلاف:	٢٠٠ جم كوشيه
عدد الصفحات بالغلاف:	١٥٦ صفحة

الأشـراف برنتنج هاوس